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S. D. KIRKPATRICK, *Editor*

# Stockpiles of Knowledge

CONGRESS has now provided that Uncle Sam shall build up stockpiles of certain "strategic" or "critical" materials for which domestic supplies would be inadequate in case of war. This seems like a sensible plan. It sets up reserves which, if properly handled, will afford a measure of protection to those chemical enterprises that must depend upon foreign countries for some of their raw materials. But there is a still further source of protection that must not be overlooked. We refer to chemical industry's increasing capacity for research and development.

American chemical engineering has greatly reduced the number of commodities that were on Uncle Sam's "critical" list during the World War. It has developed new sources for nitrogen, potash and iodine and has provided synthetics which, if necessary, can take the place of silk and rubber, camphor and phenol—to mention but a few. Further reductions in the list can certainly be expected, although there will still remain many commodities for which the most economic source is a foreign supply or for which some imports of secondary materials are needed. And there are still other commodities for which our domestic production is adequate in peace-time but entirely inadequate in a period of military emergency. This situation has created a number of problems that are of almost as much concern to chemical industry as to the Government.

For some months there have been special committees of technologists in Washington which have been working quietly, but none-the-less effectively, in studying these commodity problems. Some of the groups have dealt solely with minerals and metallic raw materials. Others are struggling with questions of industrial capacities. Still others are analyzing the present and prospective flow of certain chemicals that are needed for war- as well as peace-time requirements. Gradually there are being built up in Washington what might be regarded as "stockpiles of knowledge"—facts and figures that in a national emergency might become just as important as the physical stockpiles of raw materials which must come from abroad.

Many chemical companies are already actively cooperating with the Army and Navy Munitions Board and with other governmental agencies that are carrying on these commodity studies. A few companies have hesitated either because they do not want to take this chance of being linked in any way with military activities or because they fear that their information will be misused and ultimately get into the hands of their competitors. From our observation of the zealous way in which these figures are guarded by the War and Navy Departments, we see little cause for concern on the latter score. Nor do we regard sensible study and sound planning as militaristic in either purpose or effect. Any who have hesitated to cooperate in these commodity studies might well reconsider not only their patriotic responsibilities but also their purely selfish interests as chemical manufacturers. Both motives dictate fullest support and cooperation—keeping always in mind the vital importance of adequate knowledge as a basis for the further research and development that Uncle Sam has reason to expect of his chemical industries.

# From an

### OF THINGS TO COME

Both the New York and San Francisco Fairs have been going long enough now to evaluate their probable significance. In its own way, each is spectacular—New York by its size and grandeur, Treasure Island by its beauty and splendor. All who have visited these expositions have been impressed with their educational values, their challenge to people in all walks of life to get out of the rut of the daily job in order to think and plan for progress ahead.

Science and engineering naturally have important places in any such forward-looking program. Most chemical exhibitors have recognized and capitalized on this fundamental human interest in the problems of the future. They have helped to get across the idea that chemical industry is going to have an increasingly essential part in that future. All this adds up to better public relations and more sympathetic understanding of our problems.

### TIME FOR SAFETY

Unwittingly the cause of safety seemed to be sadly hurt by Wage-Hour Administrator Andrew's Interpretative Bulletin No. 13. Fortunately that official statement has now been reconsidered and further interpreted to encourage safe practices in industry.

It is now definitely understood that the Wage-Hour Division will regard it as perfectly proper for employees voluntarily to attend meetings and lectures and to participate in other activities in the cause of safety without having the time regarded as "hours worked" under the law. However, if safety activities are so closely related to the employee's work as to become an actual part of the company's relation to him, then the time consumed must be counted within the Wage-Hour definition of employment. Most important in deciding between one circumstance and another is whether the outside activities "are conducted as part of a general safety program which is sponsored or approved by a governmental agency or by any recognized independent organization engaged primarily in disseminating safety information." Such hours are not "at work."

Mr. Andrews has shown good sense in making such a distinction. Chemical employers will be encouraged to know that their efforts for safety among workers will not be handicapped by any narrow interpretation by the Wage-Hour Division.

### HELP MEET THIS EMERGENCY

Chemist Advisory Council, a national organization sponsored by professional and industrial leaders in the chemical industry, is doing a splendid service, but needs immediate financial support if it is to continue to function. It was organized to give advisory service to the unemployed and to provide a broad, fundamental program of guidance based on the long and varied experience of the several organizations which preceded it.

During the past year the work has been financed by voluntary contributions from individuals, companies, and associations, but now the funds are nearly exhausted. The Council hopes eventually to develop a plan for securing sufficient money for the permanent support of the work of assisting the chemical unemployed. This, however, involves considerable time. Meanwhile the need is becoming more and more urgent. Your assistance in helping to finance the modest requirements of the next few months would be gratefully appreciated in this emergency. The treasurer is Robert T. Baldwin, c/o Chemist Advisory Council, Inc., 300 Madison Ave., New York City.

### KEEPING GOODS GOOD

Many industrial plants need both conditioning of the goods which they process for correct moisture content and conditioning of the space in which these goods are handled. Thus moisture control in the material and moisture control of the air cooperate for better plant results.

In many instances an effort has been made to establish the moisture content of goods by merely exposing the material to air of such humidity and temperature as will ultimately create the desired water content of the material. For thin goods which may be exposed to the air readily, this may be an effective procedure. For bulk commodities, such a plan rarely works well either in speed or in the efficiency of moisture transfer. In fact, the cost may become prohibitive. This is the reason that a separate unit operation for treating of the goods themselves to establish the desired moisture control is often necessary, independent of air conditioning. (See *Chem. & Met.*, Oct., 1938, pp. 520–4.)

# Editorial Viewpoint

But after the goods have been so prepared in the desirable condition, they may be safely handled for considerable periods only in air that is neither too dry nor too wet. Otherwise they change in moisture content according to the atmospheric conditions and the benefits of the earlier preparation may be partly or wholly lost. Under such circumstances, after the goods have been conditioned they should be handled in rooms where air conditioning provides the proper humidity of the atmosphere so that they will stay in the optimum condition.

Engineers planning the many kinds of processing where moisture content of the material is important must take these facts into account. They will find that *goods* conditioning and air or *space* conditioning are naturally supplementary, mutually helpful operations. Neither one alone can do as good a job as the two together.

### FOR GOOD WILL, OR FOR SALES

FEW OF US in the engineering profession recognize clearly enough the distinction between efforts that are intended for direct sales stimulus and those which have the longer-time purpose of good-will building. This point is driven home by a recent inquiry from one of the most astute public relations departments in the country, the Customer Research Staff of General Motors.

That unit of the motor industry has for a long time been undertaking to guide its principals in an appraisal of the public's desire as to details of motor-car construction. But an equally important purpose has been good-will building with the public generally. They have used numerous questionnaires, and have had an amazing public cooperation. One of the recent questionnaires of this sort invites anonymous reply of criticism. It asks for the address of those who would like to receive more detailed special questionnaires. It concludes its communication with the very significant sentence which is set in bold face Italic type—"There is no sales follow-up."

In merchandising chemicals and chemical equipment there is often a proper place for sales follow-up. But there are also many proper occasions for communication with chemical engineers in the chemical process industry where the sales department should be pushed into the background, and only the good-will building considered. The two jobs are inter-dependent; but too active sales development may actually do harm when the immediate effort is for good will.

### SELLING TO CO-OPS

A RECENT ACTION of Federal Trade Commission charging price discrimination on gasoline suggests a serious problem for many industrial merchandisers. The Commission charges that American Oil Company has violated the Robinson-Patman law by selling gasoline at low price to certain agencies which are in effect cooperative taxicab groups.

This case has not gone beyond the stage of complaint, but it relates to a principle in pricing goods that must be promptly considered by many industries. If such a purchaser taking very large quantities may not get a price more favorable than the merchant who actually sells at retail much smaller quantities of goods, then new price making must be considered by many firms.

There is no proof of real competition between cab-operating groups and the ordinary gasoline merchant; but if F.T.C. can twist the federal law to mean that these two must necessarily get equal prices, then much chemical selling must be restudied. It is to be hoped that a clean-cut decision of this case can be had in order to clarify proper pricing policies.

### RUBBER'S CENTENARY

ON SEPTEMBER 13 and 14 another scientific society will pay tribute to the 100-year-old discovery of Charles Goodyear. The achievements of this great inventor as well as those of other chemists and engineers who have subsequently contributed to the advance of the rubber industry will have a prominent place in the program of the Fall meeting of the American Chemical Society in Boston. Many scientists whose names are associated with the most recent of these developments, as well as the recognized leaders of the rubber industry, will participate in this centenary program. By way of preparation and reminder, read again the very interesting and human story of the life of Charles Goodyear which Dr. Webster N. Jones prepared for our January issue, pages 14–16. Here is a stirring challenge to modern research—a story that will bear repeating many, many times.

# How Rubber Is Chlorinated

*Unique in this country is the new Hercules chlorinated rubber mill. Among the many interesting features of this plant are the closed system, materials of construction, and the tantalum hydrochloric acid absorption system.*


JAMES A. LEE

*Managing Editor*
*Chemical & Metallurgical Engineering*


CHLORINATED RUBBER has long been known but only recently has a product with good color, clarity and flexibility been developed. From this base may be formulated synthetic resin enamels, paints, varnishes, lacquers, emulsions, binders, adhesives, and plastics, with remarkable properties. It is considered to be one of the most important quick-drying materials in the protective coating industry since the introduction of nitrocellulose as a base for lacquers.

This interesting material was first prepared in the middle of the nineteenth century, but it was not until 1917, when Peachey employed a method of chlorinating a four per cent solution of rubber in carbon tetrachloride obtaining a product with 65 per cent chlorine, that a commercial process was developed. Since then numerous improvements have been made in the production of chlorinated rubber, the most recent being the preparation of a chlorinated rubber with flexibility which is retained on aging.

The new chlorinated rubber plant at Parlin, N. J., is of modern glazed tile construction. In the foreground are storage tanks; part of the acid and solvent recovery system can also be seen

Several years ago, chlorinated rubber was brought to the attention of Hercules Powder Co. After a thorough investigation of many types of chlorinated rubber, an agreement was signed securing for the company exclusive rights for the production, use, and sale of the product in this country, under numerous patents held by the Chadeloid Chemical Co. of New York; and the New York-Hamburger Gummi-Waaren Compagnie and Deutsche Tornesit G.m.b.H. of Germany.

Hercules engineers spent several months in Germany studying the process in operation near Hamburg and otherwise preparing themselves to assist in constructing a plant on this side of the Atlantic. After returning to America, further work was done to obtain a product with improved color, cleanliness, flexibility, and uniformity.

### New Plant Required

When semi-plant operations established the quality of Hercules chlorinated rubber, plans were made to increase production facilities. The rapid acceptance by industry in a short time required the erection of a much larger building. A site was selected in an isolated location at Parlin, N. J., where the company owns vast acreage, as an aid in keeping the product free from dirt and other foreign matter. Possibly further expansion of production facilities was another consideration in the selection. Construction work on the new buildings commenced last October and operations started three months ago.

When designing this new plant the engineers had the benefit of several years of experience with many types of equipment, and of even greater value, with materials of construction. This experience proved of immense value, for the product of the new

plant was found to be cleaner and otherwise better than any previously made.

The new plant is three stories high. The glazed tile that has been used on both the inside and outside is in keeping with this modern chemical process. Supported by a heavy steel frame, and utilizing steel sash and concrete floors, the building is an excellent example of good construction. One side of the building is covered with Robertson Protected Metal to simplify future expansion. This appears to have been a wise plan for already the plant is operating twenty-four hours a day and seven days a week.

Many large windows provide excellent ventilation and light. The glazed tile tends to promote cleanliness because washing is extremely simple. And, of course, all exposed interior steel work is covered with chlorinated rubber base paint although there are rarely any chlorine fumes in the plant. Overhead blower radiators provide uniform temperature throughout the building in the winter months. The visitor receives the impression that everything possible has been done to promote cleanliness and pleasant working conditions.

One of the most important factors in the design of the equipment was the selection of materials of construction. Not only were they important from the standpoint of the life of the equipment but also because of the necessity for preventing contamination and discoloration of the product. And, with hydrochloric acid and wet chlorine, two of the most troublesome of all chemicals to be handled, the problem was far from simple.

### Materials of Construction

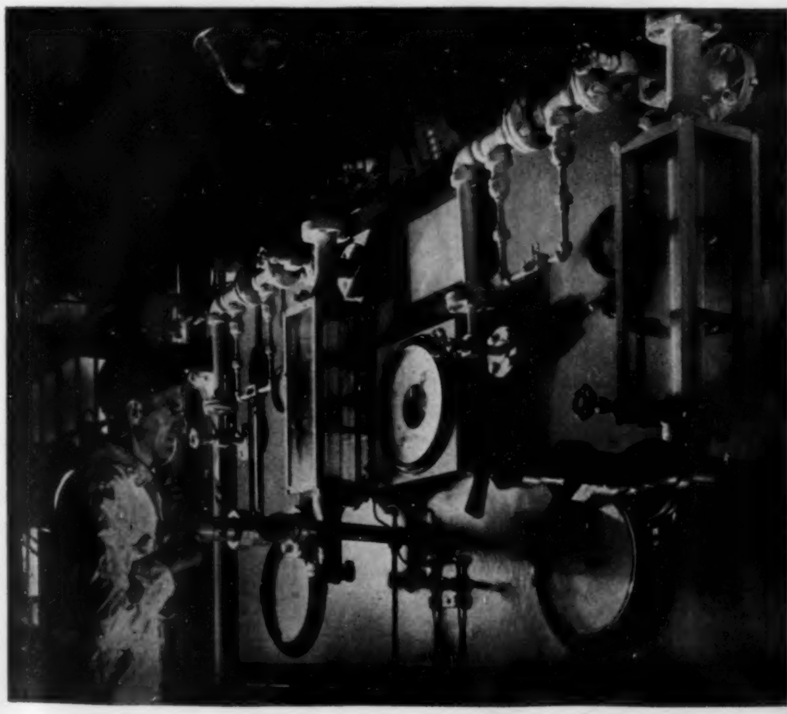
In its chlorinated rubber program, Hercules has been able to draw upon the experience of three German plants, including I. G. Farbenindustrie. For the purpose of selecting materials from which to fabricate equipment, Hercules engineers had the advantage of this experience. In selecting materials, the engineers also drew on the results of comparative tests made at the Hercules Experiment Station, and on the actual experience with various materials in the smaller chlorinated rubber plant of their own company.

Where strong hydrochloric acid or wet chlorine are handled, glass-lined vessels and piping or chemical stoneware are used. Where almost all hydrochloric acid has been washed out of the product but chlorine remains,

The starting point for Hercules chlorinated rubber is pure crepe rubber which is cut to small sizes before using

Control board instruments for recording and controlling flow of liquids and gases

All photographs used in this article were especially taken by Rittase



After chlorination, the solution is pumped to the precipitator where the chlorinated rubber is precipitated

The chlorinated rubber is given a purification treatment. It is then pumped to the top of the building where it is centrifuged

A centrifuge removes the excess water from the chlorinated rubber after it leaves purification tubs

the stainless steel, $KA_2$ SMO, is employed. Compressed air lines and water lines used throughout the building have soldered joints to prevent contamination.

The chlorinated rubber plant consists of the processing building, the storage facilities for chlorine, carbon tetrachloride, and hydrochloric acid (a byproduct of the process), and finally the saveall.

Gravity flow of materials in processing is used through the process. The raw materials are conveyed on an elevator to the second floor, cleaned and chlorinated; passed down through screens; pumped to the top floor, precipitated, passed down into purification tanks; pumped again to the top of the building for final passage through the dewatering and drying equipment, and packaged. Although this is a batch operation throughout the processing, a closed system is used between the various steps which minimizes handling, thus preventing contamination by dirt and impurities.

The processing starts with the elevation of the bales of No. 1 crepe rubber to the second floor of the building where they are unwrapped. Here the viscosity of the rubber is reduced.

The rubber is then placed in the glass-lined chlorinators where it is put into solution in carbon tetrachloride and treated with chlorine. The chlorine reacts directly with rubber to form an interesting series of compounds with properties intermediate between those of rubber and the brittle natural resins. On the basis of the structure of the rubber molecule, chlorine could add directly to the unsaturated bond giving a chloro-hydrocarbon containing 51 per cent chlorine. In actual practice, however, both addition and substitution occur inasmuch as hydrogen chloride is involved. In general a product of 66 to 68 per cent chlorine is obtained by the process.

The centrifuged chlorinated rubber is discharged into the dryer feed bin

Uniformity of product is obtained by producing large batches of the product. The operation, which requires several hours, is carefully controlled as to temperatures and pressures.

During the reaction, the vapors pass through stoneware pipe to the condensers on the roof of the building. The carbon tetrachloride returns to the reacting vessels. The hydrochloric acid and chlorine and a small amount of solvent pass over to the tantalum absorber where the acid is removed and conveyed to storage.

### Acid Recovery System

This system is of interest. It consists of an absorption column, a gas scrubbing tower, and suitable regulation or control equipment which is either automatic or manual. The mixture of gases is introduced confluently with "make" water into a tantalum absorption chamber in which the heat of absorption (approximately 1,000 B.t.u. per lb. of hydrochloric acid gas) is instantaneously removed by the cooling water surrounding the chamber. The entire system is made of materials completely inert to the action of the acid. Therefore, it is water white and pure. Acid of any desired strength up to 24 deg. Baumé is produced in a single pass through the system.

The carbon tetrachloride that passes the condensers is then scrubbed out of the gas and returned to storage for reuse.

When the chlorination operation is completed, the solution flows down into chemical brick-lined steel storage tanks. From these tanks it is pumped into brick-lined precipitating tanks which are full of hot water. The temperature of the water is varied with the type of final product desired. The solvent and steam are condensed, passed through a separator, and the carbon tetrachloride returned to storage for reuse.

### Purification

The granular material falls into a wooden tank lined with stainless steel where a thin slurry is formed. After purification, the product is again pumped to the top of the building where it is constantly circulated in order to prevent the slurry clogging the pipe line. It is centrifuged and dropped into storage bins in which it is held until a large enough batch is accumulated to load the dryer. The air passing off from the dryer is passed through both dry and wet dust collectors. The dried finished product is collected in hoppers until packed.

Hercules chlorinated rubber is packed into waterproof, paper-lined burlap bags. The net weight of the package is 75 lb. That portion intended for West Coast and foreign use is packed into 100 lb., pressed board barrels.

Chlorinated rubber is produced in five viscosities, namely, 5, 10, 20, 125, and 1,000 centipoises—(all viscosities are determined on a 20 per cent solution in toluol at 25 deg. C. in a capillary tube viscometer). The 5 centipoise type is recommended for use in printing inks; the 10 centipoise type for high solids, products such as lacquers, and as a fortifying agent for alkyd resins and oleoresinous varnishes; the 20 centipoise type for general protective coating use and for fortifying alkyd resins and oleoresinous varnishes; the 125 centipoise type for concrete floor paints, paper lacquers, and adhesives; and the 1,000 centipoise type for textile finishes and plastics as well as for other finishes requiring a maximum flexibility. The flexibility increases with viscosity.

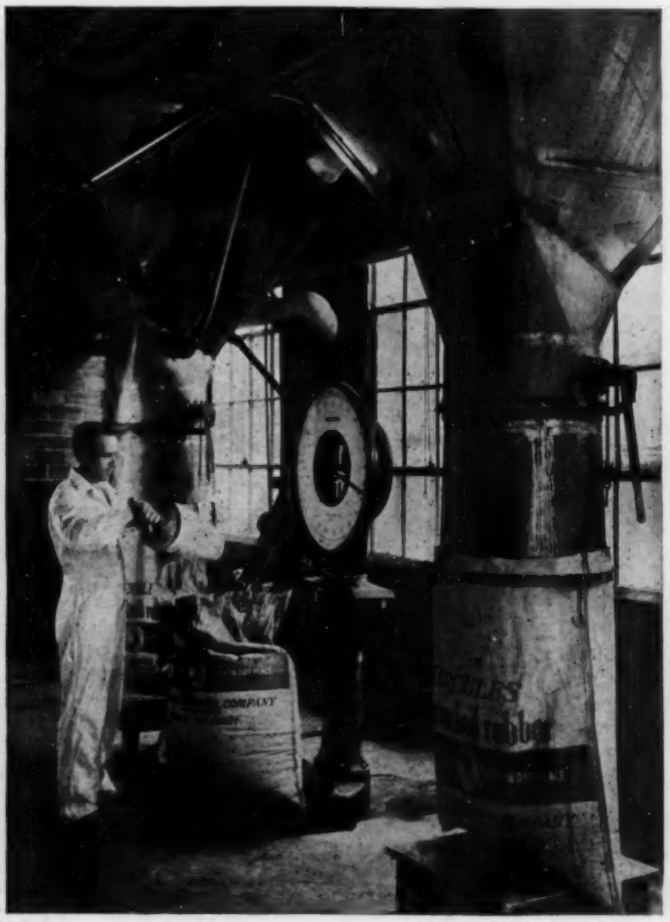
The chemicals are stored outside the processing building. The chlorine is received from the company's own plant at Hopewell, Virginia, and stored in a steel weigh tank to simplify keeping a record of the volume used and on hand. Carbon tetrachloride is held in tile-lined steel tanks. The hydrochloric acid is stored in rubber-lined tanks.

### An Achievement

Once more the ability of the Hercules chemists and engineers to improve upon a European development has been demonstrated. In the few years since securing the rights to produce chlorinated rubber in America, Hercules has improved the original characteristics and is now exporting chlorinated rubber to the markets of Europe.

The tantalum absorber converts the hydrogen chloride to aqueous hydrochloric acid

Hercules chlorinated rubber is packed in paper-lined burlap bags containing 75 lb. net



# Engineering Aspects of the Fairs

*New tools, new raw materials, and new products demonstrated in gorgeous show cases at New York and California await the visit of the chemists and engineers of America who will find them instructive and inspiring.*

## AT THE NEW YORK FAIR . . .

**EDITORIAL STAFF REPORT**

THE BRILLIANT DEVELOPMENTS and the almost unbelievable new scientific tools assembled at the New York World's Fair are a challenge to all who see them.

Visitors may become scientists for an hour, actually demonstrating many electrical research developments and performing experiments usually done only in the research laboratory, in the Playground of Science at the Westinghouse Electric and Manufacturing Co.'s building.

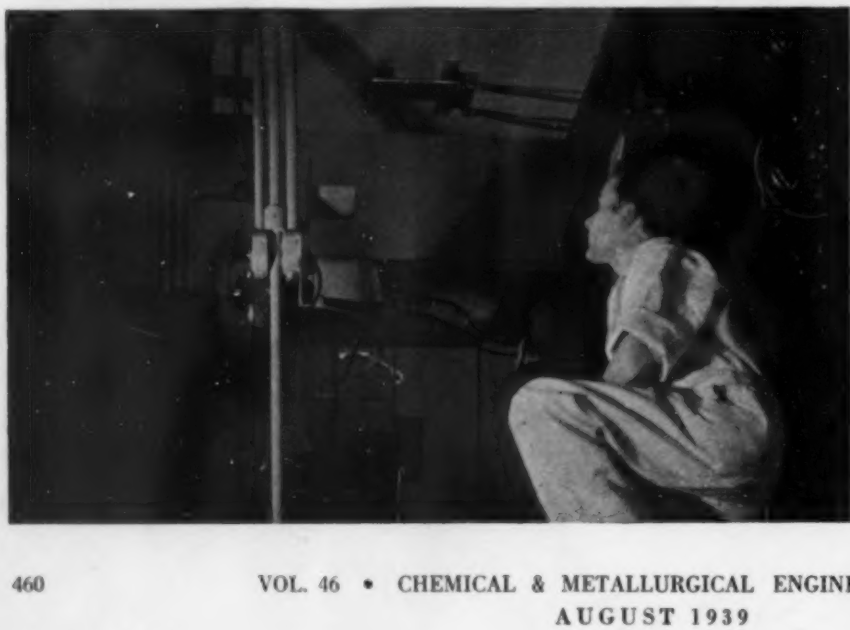
They send their voices through space over a beam of light, see the actual wave forms of their own voices, play a marimba by using flashlights instead of mallets, cause water to appear to run up hill from basin to hydrant, "blow" electric lights off and on, determine their weight by stretching a thick steel rod a tiny fraction of an inch.

By the minute amount of heat radiated by the human body, they cause electric lights to glow. They test rotating machinery for balance, learn how the intensity of light is measured, watch microscopic organisms "battle" lethal ultra-violet rays, and see myriad other demonstrations of the progress of research. Several applications of the electric eye, used in many counting, sorting and tabulating jobs to relieve human hands of monotonous and sometimes dangerous tasks are demonstrated.

Westinghouse guests also operate the Preciptron, an electrostatic air cleaning device by which more than 99 per cent of all dust particles and bacteria are removed by being "bombarded" with electrons and drawn to electrically charged metal plates in the air duct.

In the induction heater, a tube containing a metal disk moves into an induction coil and the disk becomes red hot. As the tube is withdrawn, the disk cools and an ordinary incandescent lamp nears the coil, glowing to full brilliance as it does so. Neither lamp nor disk is connected to any source of electric current. The principle of induction heating demonstrated is widely used in industry to drive gases out of metal, an especially important step in the manufacture of radio tubes.

**The exhibit of the Owens Corning Fiberglas Corp. is equipped for making continuous fiber yarns and is in actual operation. The electric furnace is shown**



Motion pictures, dramatic mural presentations, and a series of displays in the Johns-Manville Building tell the interesting story of how four of nature's minerals—asbestos, diatomaceous earth, limestone and asphalt—have been transformed through research into hundreds of products useful in industry. In the exhibits are shown the many insulating products for power plant apparatus, for industrial furnaces—and, in fact, for all types of heated and refrigerated industrial equipment—that have been developed to meet every insulation need throughout the entire temperature range from far below zero to above 3,000 dg. F.

Two huge generators, 34 ft. high, each having a capacity of 5,000,000 volts, hurl the most powerful lightning bolts man has ever made, in Steinmetz Hall at the General Electric Co.'s building. Here for the first time the general public has an opportunity to see nature's most destructive force completely harnessed by man. In one blinding flash the twin generators send a 10,000,000-volt streak, one-tenth as powerful as natural lightning, across a 30-ft. gap. Even more spectacular are some of the bolts of lower voltage. One splinters a small log. A million-volt, three-phase arc climbs 30 ft. in the air, glowing with brilliant colors from chemicals contained in the electrodes.

Features of the "House of Magic" include a sun motor which converts light energy into electric energy, a machine which causes a metal bowl to float in the air by applying the principle of magnetic induction to a non-magnetic metal, a miniature electric train run by voice radio control, an artificial fever machine and a fluorescent stroboscope.

Visitors are invited to take part in as well as see television demonstrations by stepping before the television camera for an interview. Their images are picked up on the opposite side of the auditorium in receiving sets of the type now offered commercially. The same sets also receive regular program telecasts. Other television performances may be witnessed at the R.C.A. building.

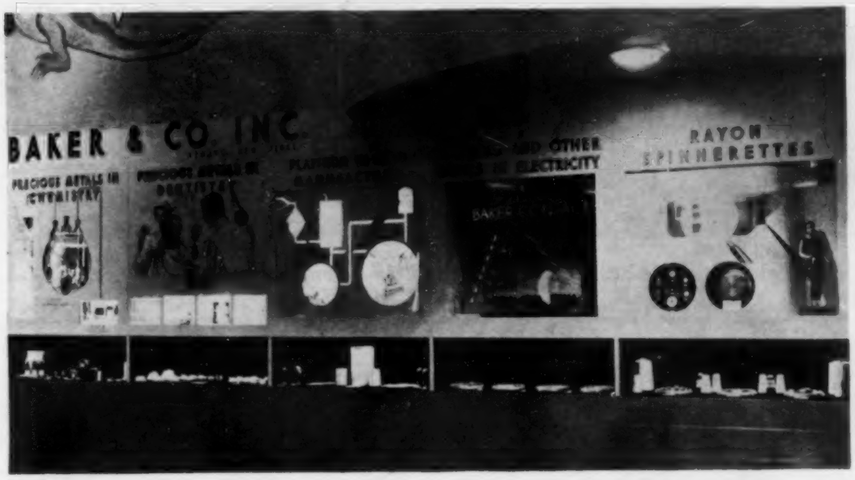
Precious metals come in for special attention in the several exhibits of the Engelhard Industries. Baker & Co., Inc. is displaying large panels of platinum clad copper. The platinum covering of 0.002 in. thickness is applied by welding. The other members of the platinum group are on display in the form of plate and numerous pieces of equipment for use in the chemical process industries. Applications in the glass industry include platinum viscosity spindles, platinum-rhodium orifice rings for furnace dies, thermocouples. In addition there are platinum spinnerettes ranging from 20 to 5,000 holes per jet, contact points, silver gauze for production of formaldehyde, and platinum-rhodium gauze catalyst for nitric acid production. Other catalysts shown are platinized asbestos, silica gel and glass wool, palladized asbestos. Rhodium solutions for plating are to be seen.

Silver anodes and solders, gold platinum and palladium foil and wire are being exhibited by the American Platinum Works. Salts of the precious metals are also being shown. And for the first time the company's new palladium catalyst is on display.

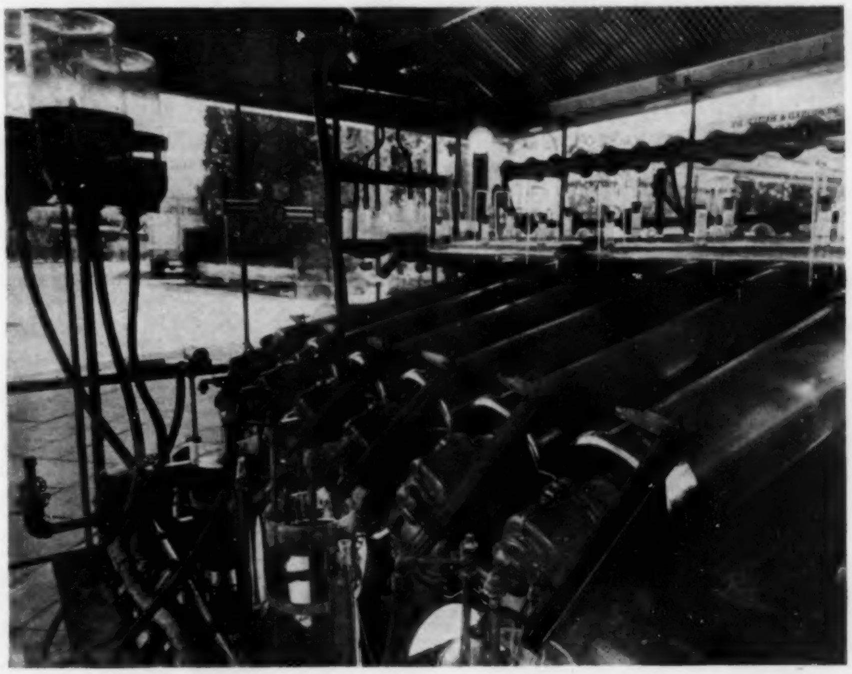
Palladium and platinum sponge and platinum salts can be seen in the display of the Irvington Smelting and Refining Works. Another of the company's products, copper sulphate, is also exhibited.

Platinum, silver, and gold preparations for ceramic uses are among the products of the Hanovia Chemical and Manufacturing Co.

A spectacular tower, symbolizing chemical research stands before the "Wonder World of Chemistry", the exhibit of the E. I. duPont de Nemours & Co., Inc. The tower incloses a greatly enlarged distilling apparatus.




**Precious metals come in for special attention in this display. Large panels of platinum clad copper and numerous other applications are shown**



**Complete six-spinnerette cuprammonium rayon spinning machine turning out spooled and twisted rayon by a continuous process**

The visitor starts around a curving hall. Here are explained the various steps toward the production of "Better Things for Better Living" from pure basic research to the manufacture of the finished products. Starting from the common raw materials from which most duPont products are derived—coal, cotton and wool, vegetable oils, ores and salt—the familiar and useful products are gradually evolved through laboratory research and pilôt-plant production. These steps are explained by commentators, and illustrated by dozens of interesting operations employing actual du Pont processes and products.

The new synthetic fiber, nylon, is shown. This material in the form of bristles for tooth brushes is inserted into the plastic holder and trimmed by automatic machinery. An injection molding machine turns out articles of cellulose acetate plastics. The actual production of cellophane is simulated by a small casting machine. Coal is separated from shale by means of heavy parting liquids in a visual demonstration of the "sink and float" process. Nearby, ceramic colors are fired, vat dyes are presented. There is a demonstration of pest con-

*(Continued on page 476)*

Golden Gate International Exposition on Treasure Island

## AT THE CALIFORNIA FAIR . . .

ROBERT LOUIS STEVENSON was no chemical engineer. His Treasure Island was a place of adventure and beauty—of tropical air. He does not record his Treasure Island as having chemical interest, but in San Francisco's Treasure Island we find not only adventure, beauty and cool air, but also an interesting chemical background. It is a man-made island, dredged out of part of San Francisco Bay, sheltered by a big rocky shield, Yerba Buena Island, to which it is connected by a short causeway.

Yerba Buena Island is one of Uncle Sam's many pieces of property in and around San Francisco Bay. It is one of the anchorages of the double-deck, Oakland-San Francisco Bay Bridge. Special roads have been built on Yerba Buena Island connecting both decks of the bridge to Treasure Island. Thus the exposition is reached easily and pleasurably by automobile. Since no plans were made for such connecting highways at the time the bridge was built, some fear was expressed before the opening of the exposition that difficulties might be experienced in handling traffic, for no stopping or turning is permitted on the six-lane bridge highways. No traffic problems have yet been encountered. Convenient "parking indicators" placed before the bridge approaches give the motorist information as to the amount of space which remains available for parking on the island and this has been found quite ample. Ferry boats reach the grounds from both bay cities within a few minutes.

The fair grounds, made of silt pumped from the salt water bay, has an abundance of beautiful shrubbery, trees and flowers. To make these grow in spite of the salty soil, required expert advice and considerable experimentation by hydraulic, irrigation and horticultural engineers. The fine silt brought down by the Sacramento River and deposited in the Bay forms a somewhat impervious filter when made into an island.

As farmer boys with hoes, some of us may not have seen much of beauty in cabbages and beets. None of us can fail to appreciate the beauty of the cabbage and beet plants grown as borders to parts of the island shrubbery. These same acres of hard-packed silt will form San Francisco's airport at the close of the Fair. Three permanent buildings of concrete were built, one airport administration building and two hangars. Two of these buildings are entirely used for fair purposes, one for administration and one of the large concrete hangars houses the marvelous collection of world-famous paintings which have brought so many visitors to San Francisco.

The second hangar is the San Francisco terminus of the Pan American Airways clipper ships to Hono-

The model town of Trona, an outstanding example of industrial relations in chemical industry, is shown as a scale miniature in the exhibit of the American Potash & Chemical Co.


The Dow Chemical Co. shows by picture and samples some of its many products and how they are used and how they are made from sea water and brine

lulu and the Orient. Flight starts of these ships are always interesting to visitors. From one end of the hangar the Pan American glass-inclosed shops allow visitors to see the work in progress.

In its own building, the Ford Motor Co. has gathered together many Western products. Attractive displays show the fabrication of these articles by means of small-scale plant models.

Petroleum refining, an important Western industry, is illustrated by an extensive small-scale model of a complete oil refinery. This is a feature sponsored by the cooperation of oil companies instead of by individual exhibitors.

Manufacturers of chemicals have emphasized the diversification and uses of their products and their services to the West. With a large and popular exhibit in the Homes and Gardens Building, the du Pont company has devoted its efforts entirely to showing how the company serves "John Citizen" in his everyday life—thus exemplifying "Better Living Through Chemistry".

The Dow Chemical Co. shows by picture and samples some of its many products and how they are used and how they are made from sea water and brine. A large amount of space in the Hall of Science has been cleverly used by the University of California to demonstrate by working models and by equipment, the activities of the University's research staff in physics and chemistry. Most interesting is the soilless growth of many plants without the benefit of sun or out-of-doors. The University of California has expended approximately $250,000 on the exhibit. Results are quite successful in popularizing its research in various fields. Great Western Electrochemical Co., now a division of the Dow Chemical Co., gives both an audible and visible presentation of its diversified products.

The desert village of Trona, Calif., was built at Searles Lake, Calif., by the American Potash & Chemical Corp. to provide residences and home facilities for its employees. This model town, an outstanding example of industrial relations in chemical industry, is shown as a scale miniature in the company's exhibit.

A special day for all engineers was set aside by the fair officials. Over 36,000 attended on that day, July 13, to honor ex-president Hoover and his fellow engineers. Mr. Hoover spoke in the morning and again briefly at the evening banquet. The principal speaker at the banquet was Prof. Rodolfo E. Ballester, Director of the Argentine Bureau of Irrigation.

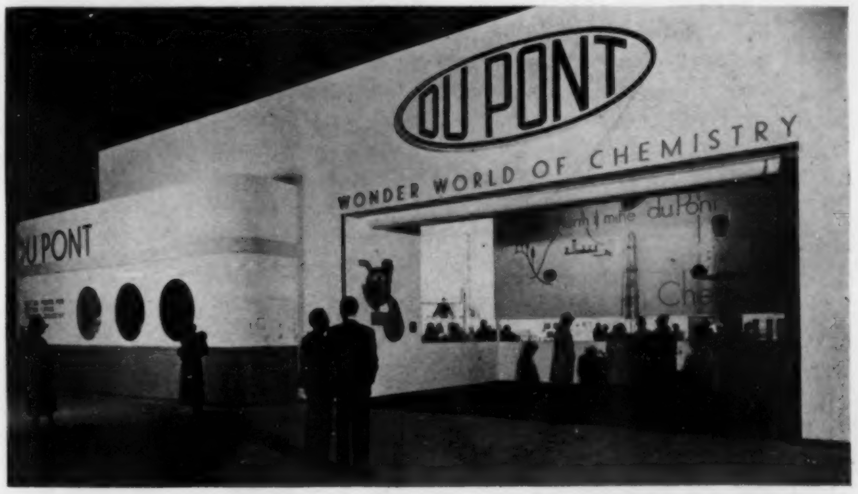
In the Mines, Metals and Machinery Building the complete story of mining is told—the mining of gold, silver, copper and iron; also simplified is the complex story of how these metals are treated and processed before they become an integral part of the every day life of every human being.

Summed up in dramatic fashion in a mammoth exhibit occupying all of the south end of the building, is Treasure Mountain; built, assembled and maintained by the California Commission for Golden Gate International Exposition. It is a replica of the typical Western mining country, stretching 160 feet long, 85 feet wide and rising to a height of 50 feet above the floor.

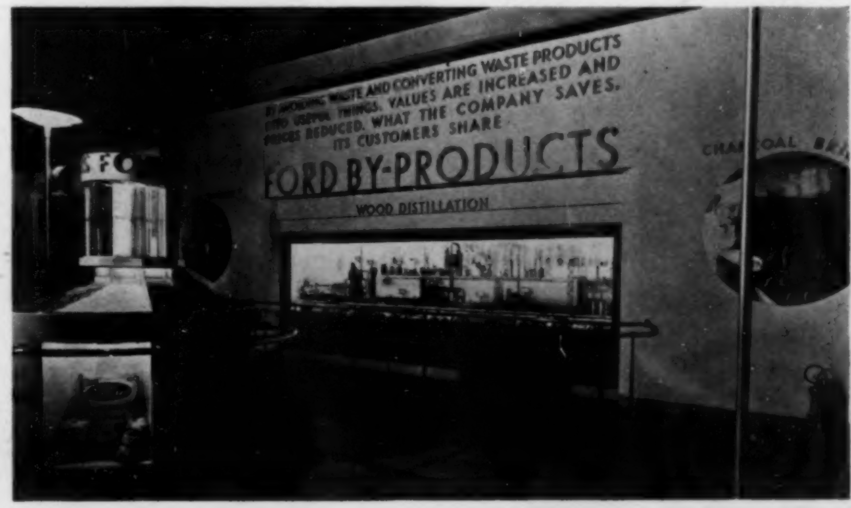
The climax of this year's technical activities was the Western Chemical Congress which convened at San Francisco's Fairmont Hotel, August 7–12. Organization of the Congress was due to Dr. Rene Engel, San Francisco consultant, who acted as secretary and managing director. Other officers of the Congress were: Sherman C. Meredith, president, Dozier Finley and R. E. Tremoureux, vice presidents, Everett Griffin, treasurer and F. W. Knipscher, finance director.

Interesting papers were read in four general divisions, industrial chemistry, food technology, metallurgy and petroleum refining.

This company has devoted its efforts entirely to showing how it serves "John Citizen" in his every day life




Many western products have been gathered together. Attractive displays show the fabrication of these articles by means of small scale plant models



# In the Nitrate Fields of Chile

***Taking sodium nitrate from the Chilean desert is no small job. American men and United States money have built a mighty industry which must now struggle for existence against modern synthetic processes.***

*TWO ADVENTUROUS young men are Helmut Schulz (right) and Howard Reichart, chemical engineers of Carbide and Carbon Chemicals Corp. Six months ago they asked for a year's leave of absence from their duties at South Charleston. W. Va., to visit chemical enterprises in far-off lands. Returning from South America they dropped in on Chem. & Met. editors and told such an interesting tale of their findings that we deemed it worth passing on to our readers. Now the travelers are hitch-hiking in Europe and we hope to have another of their worthwhile travelogs to present 'ere long.—Editor.*

H. L. REICHART *and* H. W. SCHULZ

THE NITRATE PAMPA in the north of Chile is as complete a desert as can be found anywhere in the world. This narrow plateau west of the Andes extends for hundreds of miles without a sign of vegetation, except perhaps for the occasional tree or flower box patiently nursed with imported drinking water by the sentimental wife of some American mining engineer. Not even the cactus family can survive the 365 days a year of sunshine, and the otherwise admirable climate. As far as the eye can see, it finds nothing but crusty sand, bare rocky hills, and mirages of non-existent lagoons. But things are changing according to those who call this region "home." A man in Antofagasta who remembers a dry spell of 16 years, has observed that the showers are becoming more and more frequent, until now he can count on one practically every year!

This extraordinary aridity on the coastal plateau is explained by the fact that the icy Humboldt current from the Antarctic Sea sweeps up close to the coast of Chile and thereby creates a cold zone that monopolizes all precipitation and effectively keeps moisture from reaching the land. But this barrenness imposed by nature has its compensation, for it is precisely this absence of rain for centuries that makes the nitrate beds possible. Chile saltpeter or sodium nitrate is very soluble in water, and any rains should have washed the valuable salt into the ocean long before the white man ever came to South America. Thus, the most barren spot on earth furnishes a product that finds its principal application as an essential plant food in making more productive some of the most fruitful farming districts in the world.

Caliche, the ore from which sodium nitrate is obtained, is mined from a desert in northern Chile. It is loosened with explosives in open cuts

The story of Chile saltpeter is largely the story of American business and engineering enterprise, for without American men and capital the wealth of northern Chile would likely have remained untapped. Aside from the engineering difficulties presented by the complete lack of water, transportation facilities, and sources of power, it must not be overlooked that modern cities had to be built to house 8–10,000 people at each of the two principal nitrate camps—Maria Elena and Pedro de Valdivia. The water has to be brought by pipeline from the snow-peaks of the Andes over a hundred miles distant, and all food must come from the south of Chile by steamer and specially constructed railroad. Not only a fully-equipped hospital, but schools, churches, and movies form a part of these nitrate oficinas.

It took courage to pour 70 million dollars into a foreign desert, but the Guggenheims had done the same thing before at Chuquicamata, a little further east in the same wilderness. Here they had turned a bleak hill, 10,000 ft. above the sea, into the world's greatest copper mine, and the gleaming metal has streamed from Chuquicamata ever since with a daily capacity of 1,000,000 lb. Although the Guggenheims sold Chuquicamata to Anaconda at a handsome profit after the World War had already repaid them richly, they are less fortunate with their nitrate investment. Shortly after they built their plants, the synthetic ammonia process by which nitrogen is taken right out of the air and converted into available form, became an increasingly important competitor to Chile saltpeter by virtue

**Steam shovels load the ore on railroad cars, which in turn carry it to the plant where is is crushed, leached and otherwise processed**

**Leaching vats at the Pedro de Valdivia plant. Capacity is 120,000 metric tons of Chile saltpeter annually**

Refined sodium nitrate is made into free-flowing globules by spraying in this granulation chamber. Note the spray emerging from nozzle at left

of lower production costs, until today the natural product accounts for less than 8 per cent of the world's consumption of available nitrogen. As a result an efficient plant supplying an essential product is having a hard time meeting its fixed charges.

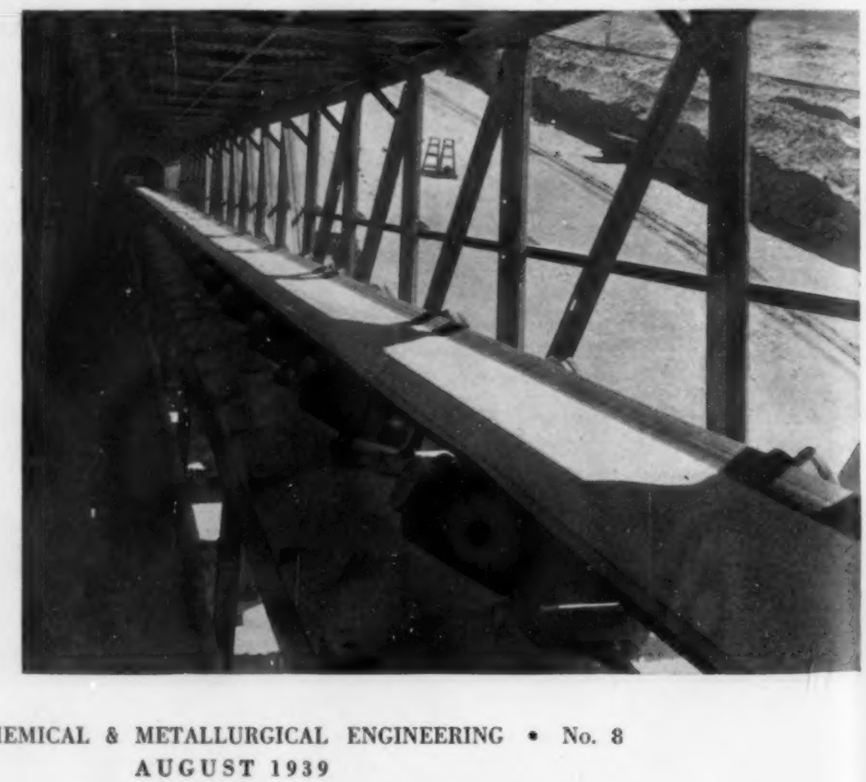
Fundamental operations involved in obtaining Chile saltpeter are quite simple. The caliche or nitrate bearing ore forms a layer varying in thickness from 2 to 20 ft., which is covered by from 1 to 12 ft. of sandy overburden. This worthless top layer is first stripped by means of big drag lines to uncover the caliche deposit. This is a rock-like formation containing 7–12 per cent sodium nitrate (Chile saltpeter), 9–15 per cent sodium sulphate (salt cake) and 6–10 per cent sodium chloride (table salt). The caliche is broken up by blasting, loaded with steam shovels, and transported to the leaching plant by means of temporary electric railways. Here the rock is crushed to small pieces and the salts are dissolved therefrom with lukewarm water in tremendous open vats. The nitrate is subsequently precipitated by cooling, and then separated in centrifuges from the other salts, which have remained in solution. Before sacking, the product thus obtained is melted and sprayed to form little globules in order to prevent caking during shipment.

Personnel at the nitrate plants is now largely Chilean, with the exception of a handful of Americans in the top executive positions. This is due in part to national law which requires that 90 per cent of the payroll be distributed to nationals, and partly to the fact that the poor rate of peso exchange makes dollar salaries a great luxury. Thus, the average workman's wage, earned by piece work, is the equivalent of only 80 cents a day.

Resident Americans live in tidy little cottages provided by the company, and can buy such luxuries as American breakfast foods or maple syrup at the company store. They necessarily make their own social life and depend on the movie and the radio as major sources of diversion. The golf course, with nothing but sand everywhere, is a rather pitiful sight. Every three or four years Americans on contract get an extended vacation to enable them to visit the United States, but during their shorter annual vacations they frequently pick a place in the south of Chile where they will be certain to encounter a good deal of rain. On weekends some of the men drive down to the ocean at Tocopilla to spend Sunday on the water fishing for swordfish. Here is the world's best spot for deep-sea fishing. In fact, the chief engineer of the nitrate plants holds the world's record—an 842 pounder full of fight, with rod and reel! In addition to the big broad bill, there are marlins and plenty of tunas. Altogether it is an ideal recreation as the moisture-laden ocean breezes act as a tonic for desert-parched lungs.

For years the taxes imposed by the Chilean government on nitrate exports produced sufficient revenue to run the entire national government because Chile had a virtual monopoly on the world's supply of nitrate and so was able to pass the tax on to the consuming countries. However, with the increasing efficiency of American and European nitrogen fixation plants reflected in lower costs, this monopoly was destroyed and Chilean exports dropped sharply. Now, the government promotes sales and parcels out production quotas in an effort to prevent cut-throat practices in supplying the amount of Chile saltpeter that can be sold in competition with fixed nitrogen. Nevertheless, the government still takes a flat 25 per cent of the profits, and since the advent of a radical "popular front" government last December, it threatens further to undermine the financial position of the nitrate producers by supporting repeated labor demands for increased wages. Although the extreme poverty of Chile would seem to justify any levy borne by foreign capital, it will profit the country little to strangle the American goose that is turning their desert sand into gold.

The final product, a fine granulated Chile saltpeter goes down a belt conveyer to be packed in bags or loaded in bulk into box cars for shipment



Every afternoon when the shifts change Kirk Hill (right) is available to his employees for a discussion of their problems whether they be personal or otherwise

PUBLIC RELATIONS for CHEMICAL PROCESS INDUSTRIES

# Personality in Public Relations

***It is generally recognized that a warm personal relation between employer and employee represents the acme in employee relations. Here is the story of a company that grew from three to 200 employees and preserved its man-to-man relationship.***

**JAMES H. COLLINS**
*Hollywood, Calif.*

KIRK HILL cheerfully admits that his company is small, for the Kirkhill Rubber Co., of Los Angeles, employs fewer than 200 people. This is an industry overshadowed by the "majors," the four great tire companies which stand as the very symbol of rubber.

When I asked Mr. Hill about public relations, he was doubtful whether his concern had developed any practices likely to be helpful to other executives. But as we went into the story of the company's growth, it developed that there was much that was interesting. Kirkhill gets along with people—from its employees to its customers, and also with the consumer public with which it now has no direct dealings. However, its methods have just grown like Topsy—always seeming to be the logical things to do at the time they were done.

Concerns many times the size of Kirkhill are today trying to get back to such beginnings—the original relations of people to each other when a business is small and everybody knows all the employees, and perhaps all the customers.

Kirk Hill started in business for himself in 1919 because he lost his job with a Los Angeles rubber company that went bankrupt. That company had manufactured chiefly tire stock for re-treading. But it had a side-line—rubber heels. These were put up in nice little boxes, one pair to the box, and sold through jobbers to both the retail trade and the consumer.

Hill had an idea that rubber heels might be sold in bulk to large shoe repair concerns, the kind that fix your shoes while you wait. He proposed to give these purchasers an edge in price by abolishing the box. His idea was sound, he raised enough money to install some hand equipment, and began selling personally, so much a pound. There were three employees at the start. That led to selling gas-hose push-ons, plumbing washers, rubber mats and other staple articles that were bought in the same way. As they were added one by one, he became acquainted with all the buyers in the Los Angeles area and spoke their trade languages.

One day, selling a bill of goods to a salvage company, he saw a pile of rubber tire bands, of the kind that were gummed onto worn treads before vulcanizing molds were made to do a better job. The company had them as the tail end of a freight claim adjustment. They were obsolete.

"What do you want for them?" Hill asked. The price was very low and he bought thirty tons, worked up the rubber into re-tread stock, and cleared enough profit to install his first hydraulic presses.

Employee relations began with the

Kirkhill's employee's aren't hired as rubber workers; they are hired for training in the plant

Press making rubber mats with vacuum cups to prevent skidding

original three hands, and were simple. The "boss" worked with them every day, taught them their trade, pointed out blunders, kidded them, knew about their financial problems, as they understood his own.

This personal relation endured as the work force grew to ten, twenty, fifty employees—added an office force and then a sales force. When growth made it necessary to establish tighter trade relations, distributing through wholesalers and eliminating direct sales, the same personal relation that had existed with repair men and similar customers was maintained with the new customers.

Today, there are 185 employees, and these relations have crystallized into policies, without losing the old personal basis. Hardly any of Kirkhill's employees have been hired as rubber workers. That term usually means an employee from one of the Los Angeles tire factories, familiar with one product—perhaps with only a single operation. The diversity of Hill's production—more than 8,000 different items—calls for wider knowledge of rubber, or the ability to learn.

#### Employees Hired for Training

Therefore, new employees are hired for training rather than upon their previous experience. There are many different kinds of workers needed—compounders, press operators, mill-men, trimmers, gasket fabricators, stock cutters, tubing machine operators. New products are being added every day, especially in the jobbing department, where many new articles are developed from engineers' designs and inventors' ideas, involving new methods in manufacturing.

Early in the development of the company, it was found good policy to try a new employee in one department, switch him to another if he didn't learn that operation, and to another, until he fitted in somewhere or it was found that he didn't belong in the rubber industry. In the latter case, Hill would scout around and find him a job in some other concern, where he often proved efficient.

#### May Change Jobs

This led to the company's present policy of allowing any employee with three years' service to try learning any other work available in the plant, and even the office, without reduction of the pay to which he has attained. For example, a young fellow was hired for the stock room, and has been a good man there, has risen to a good wage, but believes he can qualify as a press operator, which is a better-paying job. The pay for a learner in the press department is less than his present wage. If he had to start at that rate, it would be necessary to cut down living expenses, maybe to move to a cheaper house. But under this policy, he can have three months' trial at another job without reduction of pay, and the regular press operator's wage if he qualifies. If he doesn't qualify, he goes back to his old job, having lost nothing.

Last year, nine employees took advantage of this option, seven making the grade, becoming more valuable to the company, and two failing, without loss to themselves. This is the original spirit of adventure that existed in the small work force, and it leads employees to investigate and think about becoming more productive to the company and to themselves.

The old man-to-man touch is maintained in the business in various ways. Although the company now has sales offices and warehouse stocks in Philadelphia, Chicago and Dallas, the chief executive still knows everybody on the payroll. But the personal relation has taken on a little organization. Weekly meetings are held by the foremen of the six factory departments, with Hill himself attending, and many matters are discussed—employee problems as well as technical matters.

Every afternoon, at three o'clock, when a shift changes, Kirk Hill is available at his desk if any employee wants to come in and discuss either his work or his personal problems.

Since the first of this year, for example, twelve employees have built FHA homes. Such projects are discussed, as well as purchases of installment equipment like refrigerators and other family transactions. Working problems, safety hazards—anything that's on an employee's mind—may be brought out into the open in these meetings. From three to three-thirty, employees have the right of way, and even a customer waits!

The plant is now running three shifts and, as the third shift comes on at eleven p.m., Mr. Hill goes to the factory one night every week at that hour and is available to employees with similar problems.

#### The Boss Really Works

Hill often turns up for work in the factory, or one of the warehouses, takes off his coat, and helps out on a job. On the day we discussed these things at lunch, he had spent part of the morning in a warehouse where materials are kept. A large shipment of compounds had come in. There was $5,000 worth of material which needed careful handling to prevent loss; so he drove over and helped the boys look after it. The material was safeguarded and acquaintances renewed. Hill says that such turning in to help often brings out personal worries among employees, shows where a man is misplaced and leads to his transfer to some other work.

Every noon a box lunch man comes to the plant and if Hill has no lunch date, he buys a box lunch and eats with the boys. They discuss all sorts of things—Communism, Fascism, work relief, the dole, the prospects for war, the political situation—almost anything under the sun, except rubber.

There is a safety committee, of course, because there are hazards. This committee is made up of the superintendent, the foremen and employee representatives from each factory department. Safety suggestions are considered at its weekly meetings, some are referred to the safety insurance company's engineer for a technical opinion and about nine in ten suggestions are adopted. Most of them come from employees who have discovered overlooked hazards at their work.

An organization like this has a baseball team, naturally, and just now it heads its own particular Los Angeles industrial baseball league. The company pays the rent on a ball park used for practice and play, and outfits the players in new uniforms every spring. There are also bowling teams and other sport activities of the kind that arise spontaneously in a bustling industrial family.

### Company Pays for Schooling

Office employees have their option in study courses—if they feel that more knowledge will improve their work, and it is the rule that each salesman hired must attend a downtown school, taking a course in sales psychology. The company pays for his tuition.

One point is always emphasized in this outside study:

"Charlie, we are glad to spend the money if you are going to get something valuable to you out of this schooling. Please remember that we depend upon you to get our money's worth."

### Profitsharing

During the months of January, February and March all profits go to the company to meet operating expenses, taxes, depreciation and the like. Profits during the other months, excepting December, are divided on a basis of 75 per cent to the company, and 25 per cent to department heads, office employees and sales force. December is excepted because all employees receive Christmas bonuses. The reason for this policy is that during the depression when costs had to be cut, including payroll, these "white collar" employees took a reduction in salaries while wages in the plant were not affected.

Strangely, Hill has never been able to interest his employees in group life insurance. He carries ample policies himself and during the years when his death might have bankrupted the business, he carried special policies to provide cash. But employees have not been receptive to the idea of group insurance, though proposed more than once. The reason for this seems to be that practically every employee has savings, which he or she feels are an anchor to windward, making life insurance unnecessary.

### Consumer Relations

While Hill maintains that the company has no consumer relations, because it now sells nothing to the consumer, nor to retail stores, nevertheless it has consumer experience that is very helpful. For instance, among other products, Kirkhill makes branded goods like faucet washers, for distribution through jobbers.

The faucet washer, costing maybe a cent, has always been made of a comparatively soft compound, though its failure may lead to a dollar repair job by a plumber. Kirkhill made up a new line of these washers using tough oil equipment rubber, and put them on the market at a slightly higher price, under the brand "Pignose." That shows experience in meeting consumer needs, and this legacy of early days is constantly beneficial in developing similar specialties.

Making parts for many kinds of equipment manufactured in the Los Angeles area, the company deals with engineers who are designing equipment. Frequently these engineers, executives and purchasing agents are invited to see the plant. A simple supper follows a trip through the factory; then a motion picture is exhibited, showing details of rubber manufacture in both standard and special lines. This film runs to 800 ft., made entirely in color, brings out a great deal of detail, and cost approximately $100.

Knowledge of rubber gained by such visitors often leads to increased use of rubber in design, and more than once orders for rubber parts have been received from distant plants where an engineer who made the Kirkhill trip had gone to a better job.

The other day, a letter was received from a group of employees in one of the Los Angeles tire plants, asking if they could take this factory trip. They had heard about it, and secured their superintendent's permission. Their experience had been limited to tires, and they wanted to see how other rubber products were made. Of course, the request was granted.

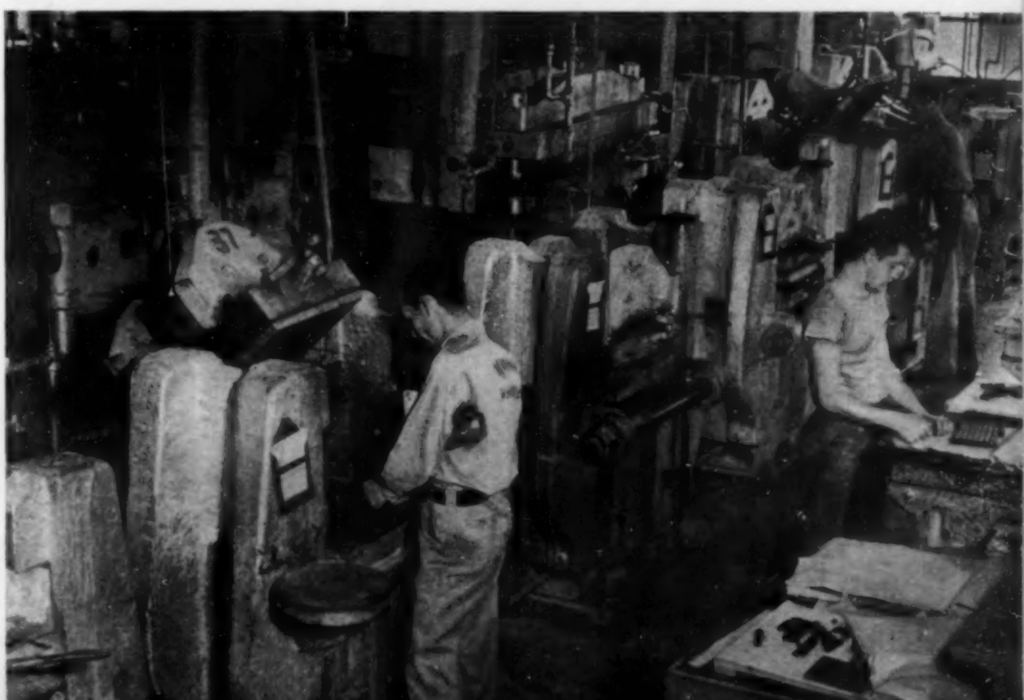
### . . . and the Orders Come In

Again, just the other day, a woman sent an order over the 'phone, and after giving details, said, "We want you to know that this order comes from Jenny's husband."

Memories were ransacked, and finally somebody recalled that "Jenny" was a friend of a friend of somebody who had formerly worked for the company, and had been well-treated. This led to a personal interest that eventually blossomed out into an order.

So, if these be the mysterious things called "public relations," that all Business has suddenly started pursuing, this small company has them and knows how to make the most of them.

Line of presses and operators in the plant of Kirkhill Rubber Co., Los Anegles

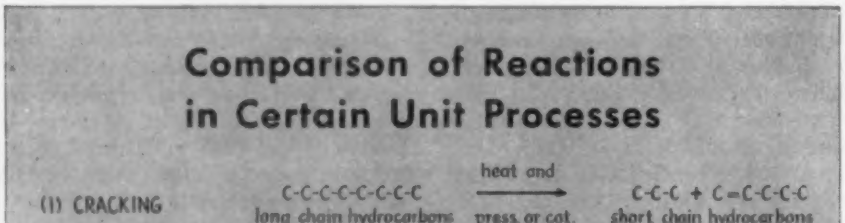


# Unit Processes in Oil Refining

*In the ever-pressing and never-ending efforts of petroleum companies to obtain better and better motor fuels, a number of interesting organic processes have been developed. Now it appears that these new processes will be useful for making many products other than gasoline.*

MELVIN E. CLARK
*Assistant Editor*
*Chemical & Metallurgical Engineering*

As the petroleum industry trends toward a chemicals manufacturing industry, the petroleum technologist tends to become an organic chemical engineer. His job now involves not only the separation of his raw material into fractions according to boiling point, but also demands that he separate these fractions into components according to chemical composition. And it further involves the altering of chemical composition to satisfy certain definite needs. This job requires more than the chemical engineering *unit operations* of heat transfer, fluid flow, distillation and filtration, which he has applied for so many years—it requries a whole new set of *unit processes** such as cracking (or pyrolysis), hydrogenation, dehydrogenation, polymerization, alkylation, isomerization, cyclozation and aromatization.




Before delving into the historical background and the present widespread commercial application of these processes, it might be well to review the chemical changes that take place. Reduced to simplest terms, i.e., the changes in carbon linkage, and considering only typical cases, the reactions proceed somewhat as in the accompanying diagram. Of course, it must be kept in mind that in every case there are numerous similar reactions, side reactions and reverse reactions, proceeding simultaneously.

A brief study of these typical reactions will show that a combination of several of these processes offers almost unlimited possibilities for the manufacture of chemicals. From the cracking process a number of hydrocarbons, in addition to those required for gasoline, are produced. They may include propane, butane, pentane, propene, butene, pentene and others. These are the hydrocarbons that form the raw materials for most of the other processes. The short, unsaturated chain compounds are polymerized to form longer unsaturated chains which are then saturated by hydrogenation. Alkylation accomplishes the same thing in one step by linking together one saturated *iso* hydrocarbon and one unsaturated. In this connection it is interesting to note that alkylation tends to double the yield of high octane motor fuel from a given cracked gas over that of catalytic polymerization and hydrogenation because for every molecule of butene, one molecule of *iso*-octane is produced.

* The distinction between unit operation and unit process is the usual one, i.e., that the latter involves chemical change while the former is merely a physical operation.

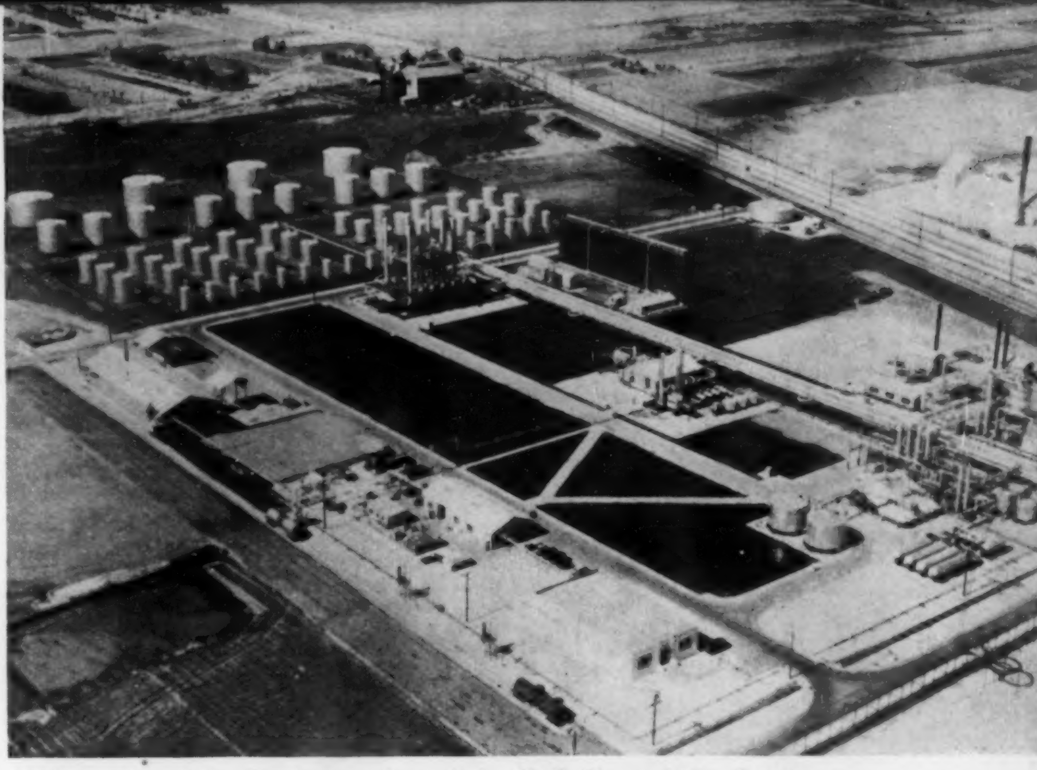
By the latter process one molecule of butene yields only half a molecule of *iso*-octane.

Now, having a straight chain saturated hydrocarbon, we can obtain a branched chain (which generally has higher anti-knock characteristics) by isomerization. Isomerization is also used to prepare suitable raw materials for the alkylation process. The next step is the transition from aliphatic to aromatic hydrocarbons which is done by cyclozation and aromatization. These two steps are usually accomplished in one process called *cyclization*. This is of interest to gasoline manufacturers because aromatics such as benzol and toluol, because of their high octane ratings (over 100), improve the quality of motor fuels.

To the organic chemist, these unit processes are far from new; they have been performed in the laboratory for decades. However, when we discuss them in terms of their commercial application, we need go back only a comparatively few years to their inception. It is not true to say that all of these processes started in the petroleum industry, yet in almost every case their claim to fame originated with their application to this important and versatile raw material. Therefore we shall, for the time being, limit our discussion to these processes as applied in the petroleum industry.

The oldest, in terms of commercial application, of these processes is, of course, cracking or pyrolysis. The Burton process dates back more than 25 years. However, the World War provided the real incentive to create a new industry founded on this improved method of making gasoline, and various thermal cracking processes sprang up like mushrooms. More recently the picture has been changed somewhat by the introduction of several *catalytic* cracking processes within the past two years. Among them is the Houdry which uses activated clay (hydrosilicate of alumina) as a catalyst and require a much lower reaction temperature than the older processes (See G. F. Fitzgerald, *Chem. & Met.* April, 1939, pp. 196–199). Other important processes in this category include the Universal Oil Products catalytic cracking process and the newer naphtha reforming process which is controlled by a group of manufacturers including M. W. Kellogg Co., Standard Oil of New Jersey, Standard Oil of Indiana and I. G. Farbenindustrie of Germany.

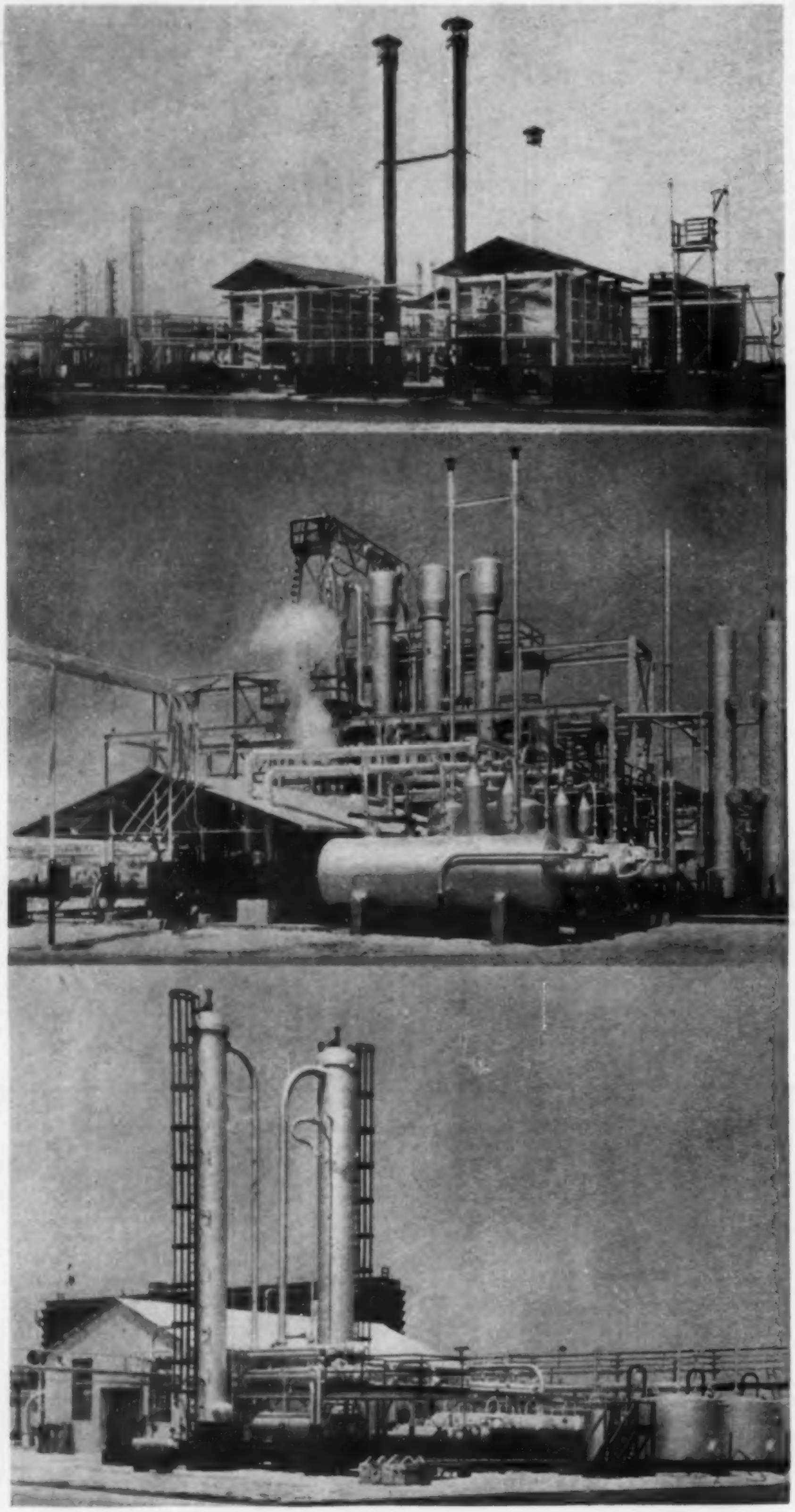
Hydrogenation is an old story in some industries, notably the hardening of vegetable fats and oils. But it was only ten years ago that the chemical engineers of the Standard Oil Co. of New Jersey adapted the new process of petroleum hydrogenation for commercial production. Two large plants were built in 1929. Since that time other plants have been installed —especially in conjunction with polymerization plants because the un-



Airplane view of the Dominguez plant of the Shell Chemical Co. Dominguez, Calif., where chemicals are made from petroleum

**Operating Features of Some of the Important Processes in the Petroleum Industry**

| | Cracking | | Polymerization | | Hydrogenation | Dehydrogenation | Alkylation | Isomerization |
|---|---|---|---|---|---|---|---|---|
| | Thermal | Catalytic | Thermal | Catalytic | Catalytic | Catalytic | Catalytic | Catalytic |
| Process (all in commercial operation) | *Liquid phase*<br>Dubbs<br>Cross<br>deFlores<br>Holmes-Manley<br>Tube & Tank<br>Combination<br>Uni-Coil<br>*Vapor phase*<br>True Vapor Phase<br>Alco & Gyro | Houdry<br>U.O.P.<br>Catalytic<br>Ref. Group<br>(S.O. of N. J.,<br>S.O. of Ind.,<br>German I.G. &<br>M.W. Kellogg) | Alco-Pure Oil<br>Unitary<br>(Polyco)<br>Multiple Coil | U.O.P. Selective<br>U.O.P. Non-Selective<br>Houdry<br>Polyco<br>Shell *Iso*-octane | S.O. of N.J.<br>U.O.P.<br>Shell | U.O.P.<br>Shell | S.O. of N.J.<br>Shell<br>The Texas Co.<br>A.I.O.C.<br>Humble<br>S.O. of Ind.<br>U.O.P. | U.O.P.<br>Shell |
| Catalysts | ................ | activated clays (natural and synthetic) | ................ | phosphoric acid<br>hot sulphuric acid<br>cold sulphuric acid | activated nickel metal oxides | Aluminum and chromic oxides | sulphuric acid<br>aluminum chloride<br>boron fluoride | aluminum chloride |
| Reaction temp., deg. F. | 850–1,100 | 800–1,000 | 1,000 | 175–400 | 500–1,000<br>400 | 1,050 | 35–100 | 200 |
| Reaction press., lb./sq. in. | 50–1,500 | atm.-200 | 600–2,500 | 150–1,500 | 1,500–4,500<br>60–100 | atm. | about atm. | 200 |
| Raw materials | high-boiling petroleum fractions | gas oil<br>reduced crude | propane<br>propene<br>buanes butenes | propene<br>butenes | unsat. hydrocarbons | butanes<br>propane | *iso*-butane plus butene | *n*-butane<br>*n*-pentane |
| Products | gases — $C_1$, $C_2$, $C_3$ & $C_4$, sat. & unsat.<br>gasolines<br>fuel oil | gases<br>gasoline<br>gas oil<br>fuel oil | high-octane gasolines (many olefines) | high-octane gasolines | saturated hydrocarbons | butenes<br>propene | *iso*-octane | *iso*-butane<br>*iso*-pentane |
| Capacities, bbl. per day throughout | 500–35,000 | 3,000–18,000 | 1,000–10,000 | 50–5,000 | 1,000–10,000 | 450–1,000 | 1,000–2,500 product | ?? |
| Yields, per cent | Depends on charging stock, conditions and catalyst | | 45–55% | Almost theo. on *iso*-butene. Others depend on product | 95% on hydrogen | 90% | 100% | 70–80% |
| Gasoline octane number obtainable | 67–80 | 78–82 | 75–80 | 80–85 | 90–100 depending on charging stock | ............... | 90–100 | Process used to prepare charge for alkylation |



Chemicals are now made from petroleum on a large scale in modern equipment such as that shown above. From top to bottom the units shown are: ketone stills, reactors and crude alcohol columns, and a hydrocarbon purification plant — all at Shell Chemical Co.

saturated product of the poly plant must be saturated to meet the requirements for high quality motor fuel.

The most recent developments along this line, however, have been in dehydrogenation. Plants are now being operated and more are being built which dehydrogenate saturated hydrocarbons to form $C_4H_8$ and $C_3H_6$ compounds. This is done both catalytically and thermally. The products are used as feed for the alkylation process. U.O.P's dehydrogenation process operates catalytically at atmospheric pressure (see table).

Polymerization became a factor in petroleum refining less than five years ago with the advent of both the thermal and catalytic processes. The world's largest thermal plant built by M. W. Kellogg Co. for the Humble Oil Co. in 1936 was described in *Chem. & Met.* in August, 1938, pp. 412-15. Universal Oil Products Co. now has more than 60 catalytic poly units in commercial operation, or under design or construction. These plants have production capacities ranging from 18 to 2,500 bbl. per day of 81-octane gasoline. The so-called midget units (18-215 bbl. per day) are now being constructed in many refineries at a cost of from $15,000 to $35,000. U.O.P. also has a number of iso-octane units in various stages of construction and operation, which range from 50 to 800 bbl. per day capacity. Those units actually operating produce from 200–450 bbl. per day by a combination of selective polymerization and low pressure hydrogenation. The product is a 95–96 octane aviation gasoline and the catalyst for the polymerization step is "solid" $H_3PO_4$. Another important process in this category is the so-called *iso*-octane process of Shell Development Co., which combines polymerization with hydrogenation to produce a synthetic aviation fuel of 100-octane rating. The catalyst is cold sulphuric acid.

Although many of these processes are not as new as recent publicity would seem to indicate, alkylation is the one that is now widely talked of as the outstanding process for making the aviation fuel of tomorrow. As a matter of fact, a substantial part of the aviation fuel of today is made by this process. In England, the process has been in operation for at least two years. In the United States, a small commercial plant has been operated by Standard Oil of New Jersey for more than a year. A larger plant, 1,100 bbl. per day output, is now being operated in the South and a 2,500 bbl. per day

plant is being constructed for the Magnolia Petroleum Co. at Beaumont, Texas, by the M. W. Kellogg Co. It is scheduled for completion in November. The process used is one controlled by a group including Standard Oil of New Jersey, Anglo-Iranian Oil Co., Shell and the Texas Co. Using cold concentrated $H_2SO_4$ as a catalyst, the new process produces gasoline of 90 to 95 octane rating from *iso*-paraffines and unsaturated hydrocarbons. Another large plant using this same process is now being constructed by the Lummus Co. U.O.P. and Standard Oil of Indiana are understood to have processes in this category.

The impetus for the development of the alkylation process has been, of course, the race for gasoline of higher and higher octane number. The 68-octane fuel of a few years back is not good enough for modern air transportation. Military and commercial airmen are demanding 100-octane gasoline and they are getting it. By treating the alkylated gasoline of 90 to 95 octane rating with tetra-ethyl lead, an airplane fuel of 100 octane and more may be obtained. Now it is even reported that one major oil company is planning to construct, within a few months, a plant to make 150-octane gasoline—and at a cost of about 18 cents a gallon! This seems surprising indeed when compared with the statement of an internationally known petroleum investigator that a year ago it cost $3,600 to make a gallon of 125-octane gasoline and that recently the cost had been lowered to $50 a gallon.

Finally, isomerization and aromatization are also out of the pilot-plant stage. In the case of the former there is at least one large commercial installation. The latter has a continuous pilot plant in operation and commercial plants are being built.

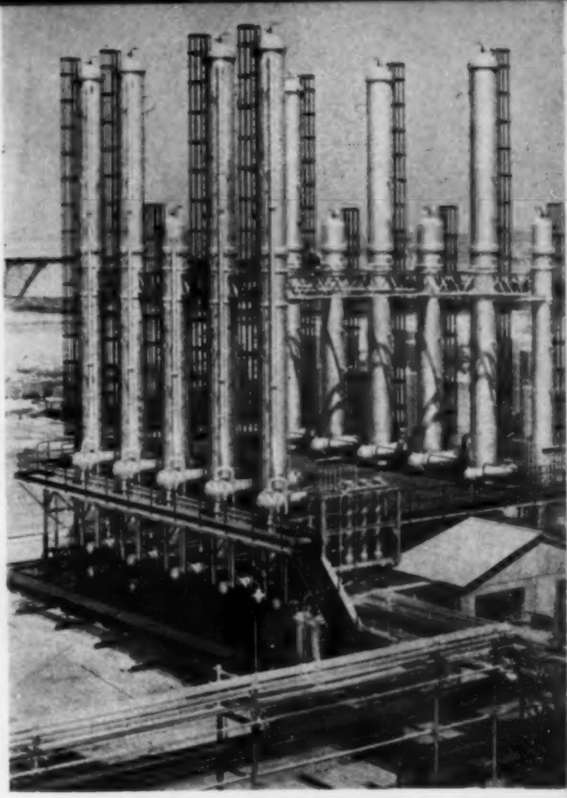
For a comparison of the operating characteristics of some of these processes, the reader is referred to the accompanying table (page 471). Again the data are only typical and not all-inclusive. It is interesting to note that catalytic processes have materially reduced the temperatures and pressures formerly necessary. A thermal process might be compared to a sledge-hammer method of treatment, whereas the catalytic process more nearly simulates a tack-hammer treatment. Nevertheless, we must not assume that the more skillful tack-hammer method is universally applicable. For many uses we must still resort to the sledge-hammer. For this reason the bulk of crude petroleum and heavy fractions will probably continue to be cracked by thermal methods for a long time to come.

Now that we have seen how the chemical engineer adds or subtracts a carbon atom or a group of carbon atoms at will, how he saturates and unsaturates the carbon chain, how he changes from one type of chemical compound to another—we can readily understand why the petroleum industry is becoming an ever-greater source of new chemicals.

Space prohibits even a partial listing of the chemicals that have already appeared on the market as a result of these comparatively new processes. Suffice it is to say that they include most of the common alcohols, a number of glycols, ethers, ketones, chlorinated solvents, acetylene, and of course, the newly announced synthetic glycerine. All of these have numerous derivatives that are made directly or indirectly from refinery gases.

Merely as an indication of some of the higher derivatives that are now produced, we cite a list of compounds made by Shell and available in limited quantities through their chemical affiliate — Shell Chemical Co. They are:

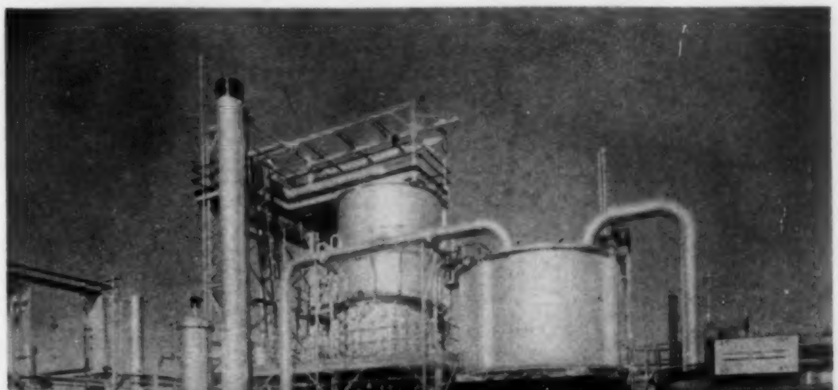
Allyl alcohol
Methallyl alcohol
Allyl chloride
Methallyl chloride
Isocrotyl chloride
Trichloropropane
Diallyl ether
Dimethallyl ether
Glycerine monochlorohydrin
Glycerine dichlorohydrin
Epichlorohydrin



**In these columns the delicate fractionation work necessary at Shell is carried on**

How far the unit processes of petroleum will go into the field of chemical manufacturing is impossible to predict. Whether they will replace existing methods of making many chemicals is only a question of time. Meanwhile, even in those cases where they cannot or do not compete with existing processes, they act as a stabilizing influence on the price structure and valuable insurance against shortage due to war or any other cause.

**The acid concentrator shown here is a part of Shell's Dominguez operations**



# Fractional Digestion of Pulp

*By use of fractional digestion the troublesome constituents of fibrous raw materials are removed before the pulping operation. This makes bleaching easy and economical says the author, an M. I. T. chemical engineer*


**KANTILAL M. PAREKH**
*Bombay, India*


BAMBOO PULP is being produced 'n India by the fractional digestion process developed by W. Raitt and his associates. It can be economically bleached to the point where it is comparable in color to pulp made by the sulphite process.

Digestion is generally thought of as a process for producing pulp while in reality it is the removal of all non-cellulosic constituents in the raw material. In order to properly deal with these constituents, it is necessary to know what they are, the amount of each, the solubility of each, their combining equivalents and how such combinations react upon the cellulose residue, particularly in regard to color. In the case of bamboo these substances are of marked individuality. It seems advisable to divide them in the following four groups:

Group 1—Starch, its secondary and transformation products including sugars, tannins, water soluble gums, earth-salts and coloring matter. All neutral substances are soluble in water at 100 deg. C.

Group 2—Pectins, with small amounts of fat, wax, resins, gums and earth-salts insoluble in water. All acid bodies and those soluble in 1 per cent caustic soda at 100 deg. C.

Group 3—Lignins, acid bodies soluble in 4 per cent causic soda at temperatures above 130 deg. C.

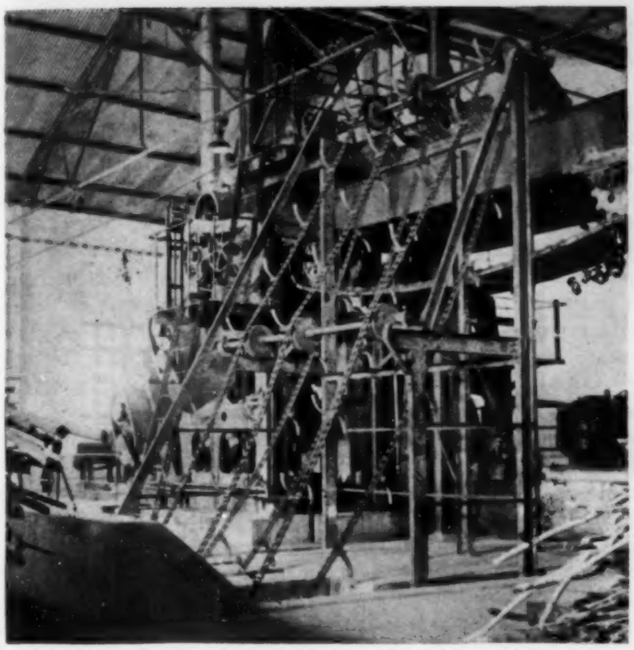
Group 4—Cellulose, the insoluble residue from the above.

Constituents of Group 1 produce during digestion a dye which stains the pulp, is not entirely washable, and is extremely difficult to bleach. Group 2 produces a malignant, non-washable, unbleachable, and permanent dye on the pulp and where these dyeing reactions are allowed to take place, the bleaching results in a cream-white product. Therefore, it is necessary to separate the cellulose from the starch, pectins and lignins. The factors in the separation are: (a) Time, i.e., the period the digestor is under steam, reckoning from the boiling point; (b) Caustic soda in its relation to combining equivalents; (c) Caustic soda in its relation to liquor density; (d) Temperature; (e) Hydrolyzation of fiber; (f) Oxidation of fiber during the subsequent bleaching process. Of these the two active factors are *c* and *d*.

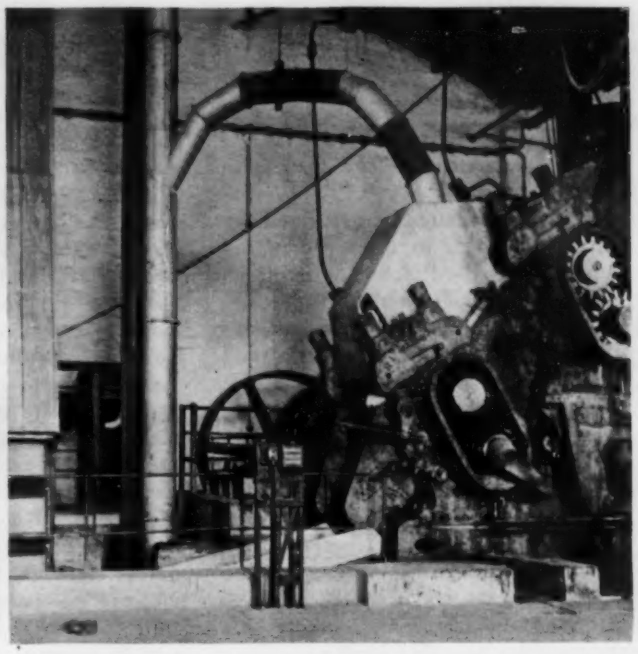
*Liquor density in relation to Groups 1 and 2*—As has been mentioned, these groups are soluble in 1 per cent caustic soda solution at 100 deg. C. with a safe maximum density of 2 per cent; but in 4 per cent solutions a secondary carbonation occurs which consumes a further 1½ per cent caustic soda on the raw material—a sheer waste. This is what occurs in overhead digestion where these groups meet a density which is never below 4 per cent and their solution is nearly complete before the temperature has risen to the minimum for lignin solutions.

*Liquor density in relation to Group 3*—Efficient density for this group is about 5 per cent, whereas at 7 per cent there are evidences that it becomes an active factor in hydrolysis. It is evident that in overhead digestion the initial density is almost at once reduced by Groups 1 and 2 and the active density remaining for Group 3 is lowered to an entirely ineffective point unless its initial strength has been bolstered with a large excess of

Bamboo rafting on its way to the pulp and paper mills



Bamboo carrier, chain gear, with hooks, handling 16-ft. lengths from bottom to top of crusher. At extreme right is a pile of bamboo



Other side of crusher, showing crushing rolls and flue type carrier, which carries bamboo to top of digester house with help of blower

soda, an excess wholly useless from the combination point of view and which passes away in the spent liquor as unused, uncombined soda.

*Temperature*—High temperature is evidently the most active factor in the hydrolyzation of fibers. An increased temperature of about 10 per cent causes somewhere in the neighborhood of twice as much fiber loss as a similar increase in density would cause. It is therefore of importance to use as low a temperature as possible. Further, it is apparent that there is a neutral region above 130 deg. C. and ending somewhere between 138 deg. and 145 deg. within which hydrolysis is not appreciably greater than at 130 deg. Digestion is possible at 130 deg. C. in a high caustic soda concentration in about 18 to 24 hours. The higher the temperature above 130 deg. C., the shorter the period. If, therefore, the point of "critical temperature" could be fixed one would have a range of safe temperature creating a valuable weapon to be used against time. Again it seems queer that hydrolysis is not active at any temperature until late in the process—not until, in fact, the cellulose is divested of its lignin protection. It might, therefore, be possible to save further time by using an initial temperature considerably above the critical point—perhaps 150 deg. C., provided it is lowered to that point (142 deg. C.), where lignin is softened and about to pass into solution.

*Time*—Time is an auxiliary to the temperature and density factors and has no specific action of its own. Time has, however, a relation to mill economy which the others scarcely possess. The time for the lignin digestion is about three hours which with the two hours necessary for the extraction of Groups 1 and 2, gives a total steaming period of five hours.

**Production of Pulp from Bamboo[1]**

| Description | |
|---|---|
| Culms of all ages dealt with | Mixed |
| Nodes | Usable |
| Soda consumption on bamboo | 16% |
| Bleaching powder used on unbleached pulp | 8% |
| Digestion temperature, average throughout the process expressed in steam pressure per square inch | 30 lb. |
| Steaming time of digestion | 5 hr. |
| Pulp-yield, unbleached | 45% |
| Pulp-yield, bleached | 42% |

[1] From the Digestion of Grasses and Bamboo for Paper-Making, by W. Raitt.

**Comparative Factors for Bamboo and Other Pulping Materials[1]**

| | DESCRIPTION | Bamboo, (Bambusa Arundinacea). | Bamboo. (Dendrocalamus Strictus). | Bamboo. (Melocanna Bambusoides). | Bamboo. (Ochlandra Brandisii). | Baib Grass. (Ischaemum Angustifolium). | Savannah Grass. (Anthistiria Gigantea). | Esparto, Oran. (Lygeum Sparta). | Wheat Straw. | Spruce Wood. |
|---|---|---|---|---|---|---|---|---|---|---|
| | N. A. D.[2] raw-material | I | II | III | IV | V | VI | VII | VIII | IX |
| ANALYSIS | Group I. Starches | 5.47 | 5.10 | 3.15 | 5.47 | 13.00 | 13.13 | 9.22 | 7.75 | 4.01 |
| | Group II. Pectins | 20.13 | 16.44 | 17.41 | 20.53 | 26.00 | 25.36 | 29.17 | 27.59 | 2.72 |
| | Group III. Lignins | 15.23 | 15.28 | 15.54 | 14.90 | 5.47 | 5.64 | 5.59 | 8.31 | 32.18 |
| | Group IV. Cellulose | 49.17 | 53.18 | 53.90 | 49.10 | 45.53 | 45.67 | 46.02 | 46.35 | 49.09 |
| | Ash | 2.56 | .... | 3.05 | 3.00 | 5.13 | 5.12 | 3.84 | 2.70 | 0.05 |
| | Fat and Wax | 1.05 | .... | .... | .... | 2.64 | .... | 2.50 | 1.24 | .... |
| MILL DIGESTION | Groups I & II. | | | | | | | | | |
| | Temperature °C | 115 | 115 | 115 | 108 | 108 | 115 | 108 | .... | .... |
| | Time, hours | 2 | 2 | 2 | 2 | 1 | 1.5 | 1 | .... | .... |
| | Liquor density | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | .... | .... |
| | Groups III & IV. | | | | | | | | | |
| | Temperature °C | 158 | 153 | 153 | 153 | 140 | 153 | 140 | .... | .... |
| | Time, hours | 1 | 1 | 1 | 0.5 | 2 | 0.5 | 2 | .... | .... |
| | Temperature °C | 140 | 140 | 140 | 140 | .... | 140 | .... | .... | .... |
| | Time, hours | 2 | 2 | 2 | 2.5 | .... | 2 | .... | .... | .... |
| | Liquor density | 5 | 5 | 5 | 5 | 4 | 5 | 4 | .... | .... |
| | Digestion demand in terms of NaOH | 18.00 | 17.00 | 17.00 | 16.00 | 11.25 | 17.00 | 12.00 | .... | .... |
| | Unbleached pulp | 42.00 | 44.41 | 45.00 | 47.92 | 40.77 | 42.00 | 44.50 | .... | .... |
| | Bleached pulp | 37.80 | 40.88 | 42.90 | 43.30 | 37.80 | 37.50 | 42.00 | .... | .... |
| | Bleaching powder consumed on raw material | 3.09 | 3.67 | 3.60 | 3.24 | 2.22 | 3.24 | 2.70 | .... | .... |
| | Average temperature | 134 | 133 | 133 | 129 | 129 | 132 | 129 | .... | .... |
| | Total digestion time | 5 | 5 | 5 | 5 | 3 | 4 | 3 | .... | .... |

[1] "From the Digestion of Grasses and Bamboo for Pulp-Making" by W. Raitt.
[2] Normal air dry, which means 10 per cent moisture in raw material.

The development of fractional digestion has opened a new chapter of more or less general application. The fractional system aims at reducing the cost of digestion and improving the quality and yield of pulp from raw materials carrying considerable amounts of starchlike and pectous matter. Bamboo contains from 20 to 23 per cent of these constituents. Fractional digestion takes into consideration the wide differences in solubility of the three chief soluble constituents: starch, pectin and lignin.

By extracting the starch and pectins prior to the attack on lignin, the pulping action occurs in a non-staining medium (lignin liquor), and the degradation of the color, inevitable under any method which permits the starch and the pectin liquors to be present at this stage, is prevented. Liquor density is an important factor. By applying the efficient densities to the soluble constituents, it is possible to obtain a reduction in temperature and in time of digestion resulting in an improvement in yield and quality. By eliminating the starch and pectin groups prior to pulping the final washing of the pulp is reduced and the soda recovery is improved.

The raw material, crushed bamboo, is first extracted at a temperature of 100 to 115 deg. C. for about two hours with a partially exhausted alkaline solution containing 1 to 2 per cent of active alkali from the lignin digested. The easily hydrolyzable constituents such as starch and pectin are dissolved by the caustic from the crushed bamboo without serious decomposition and are removed when the liquor is discharged. This process is known as pre-digestion. The material free from starch and pectins is then digested with fresh caustic (about 5 per cent). The best results are attained from the sulphate method, by mixing 67 to 75 per cent caustic with 25 to 33 per cent sodium sulphide. In this lignin digestion process bamboo requires three hours in all with one hour at the initial temperature of 150 deg. C. and the remainder at 140. The cellulose is then liberated from this digestion without being stained while the digested caustic solution containing a sufficient excess of free alkali is used for the pre-digestion of the next batch. By this method soda or sulphate pulp may be produced from materials such as bamboo that have just as good color as the sulphate pulp and are capable of being bleached with ease, consuming only 3 to 4 per cent standard bleaching powder on the raw material.

Before concluding it is interesting to note that somewhere about 250 species of bamboo have been identified and every year adds to this number. They vary from pygmies of 1 ft. in height to giants of 120, and in diameter from ¼ inch to 8 inches. Bamboo is capable of producing a wide range of grades of paper, from a first class printing to resin-sized writing paper and litho paper in one direction and strong brown kraft in the other, and will blend with any other stocks.

At the present time India produces around 50,000 tons of paper, mostly from bamboo pulp. Undoubtedly, in the event of any serious exhaustion of the world's supply of pulpwoods, bamboo stands in a favorable position to be an important source of cellulose fiber for paper-making. Owing to its rapid growth the supply is capable of almost unlimited development.

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## NEW YORK WORLD'S FAIR

*(Continued from page 461)*

trol work, showing how science fights insects pests. The milling and testing of neoprene, with demonstrations that show how it improves on nature's own rubber for many purposes are shown.

Sulphur is the attraction of the exhibit of the Texas Gulf Sulphur Co. A model of a sulphur atom magnified many million times is the main feature. The tile flooring is of interest as a sulphur cement has been used.

The story of the acrylic resins is told by the Rohm & Haas exhibit in the Hall of Industrial Science.

Through colorful, animated displays, this exposition brings the dramatic story of Bakelite plastics. It reveals how plastics are used to advantage in industry. There is an opportunity to see at first hand how plastics are made. Automatic injection molding presses are installed and molding polystrene objects which serve as souvenirs.

In the patio outside the Glass Center stands a stylized dramatic exhibit symbolizing and portraying the various properties of glass in unique fashion. The rotunda, or main circular hall, contains an operating glass furnace where experts show in complete detail the making and blowing of glass objects. In another part of the building a complete miniature plant has been set up to demonstrate the manufacture of fiber glass yarns.

The visitor to the transportation section will be surprised to find there, in the exhibit the Edward G. Budd Mfg. Co., a complete six-spinnerette cuprammonium rayon spinning machine, turning out spooled and twisted rayon by a continuous process which requires but 2½ minutes from spinnerette to finished yarn. The answer to this apparent enigma is that the machine is the type used by the New Process Rayon Co., which was developed by W. H. Furness (see *Chem. & Met.*, June 1932, p. 326).

Engineers interested in materials of construction that will resist plating solutions and other corroding agents will want to see the demonstration of Flexlock pipe joints coupled with the U. S. Stoneware piping in the B. F. Goodrich Co.'s building.

Also a demonstration of the vinyl resin, Koroseal, is made in the Goodrich Building. The resin is produced and extruded in the form of various objects. In addition, fabrics treated with the resinous material in order to obtain special characteristics are also on display.

How it is practical to ease labor's burdens, and expedite production and reduce costs by using bucket elevators, screw conveyors and other mechanical conveying equipment for handling materials from where they are to where they are wanted next is part of the Link Belt Co.'s exhibit in the Metals Building.

In the Borden Building can be found Pfaudler's exhibit of glass-lined tanks and other equipment.

An asbestos mural dominates the exhibit of the Keasley and Mattison Co. in the Home Building Center. Standing 21 ft. high, it depicts the Spirit of Asbestos protecting the possessions and creations of man from the onslaught of heat and cold, weather and the elements.

In the Ford Motor Co.'s building may be seen production of synthetic fiber from soybeans on a small scale.

A model porcelain enameling plant is one of the features of the Ferro Enameling Corp.'s exhibit in the Home Furnishings Building. The U. S. Potter's exhibit contains a complete plant for making and burning pottery.

The visitors to the Fair may see these and many, many more exhibits of interest to the chemist and engineer.

# Contact Acid From Pyrites

As sulphuric acid goes, so goes industry! For many years this largest tonnage product of the chemical industry has been a substantially accurate gage of the state of industry in general.

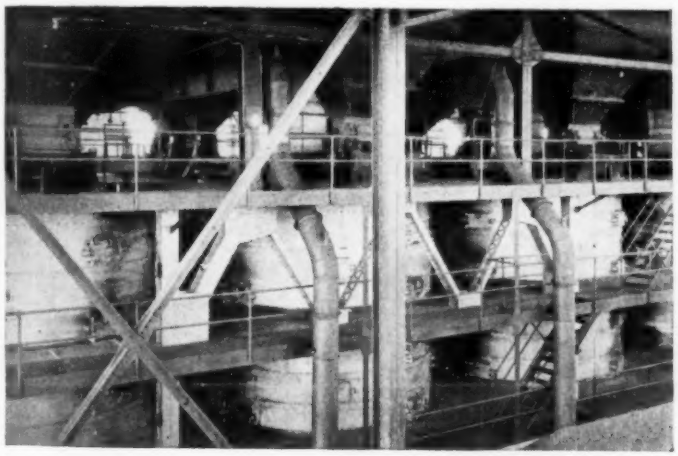
The two industrially important methods of making sulphuric acid are the contact, and lead chamber processes, each of which accounts for substantially half the total production, with the former on the increase.

The chamber process makes acid of strengths up to but not in excess of 60 deg. Bé. (77.67 per cent $H_2SO_4$), whereas the contact process is fundamentally a producer of sulphur trioxide, which is combined with water by absorption in 97-99 per cent acid to form any desired strength up to approximately 40 per cent oleum ("109 per cent" $H_2SO_4$). Acid strengths lower than 98 per cent $H_2SO_4$ are made by dilution.

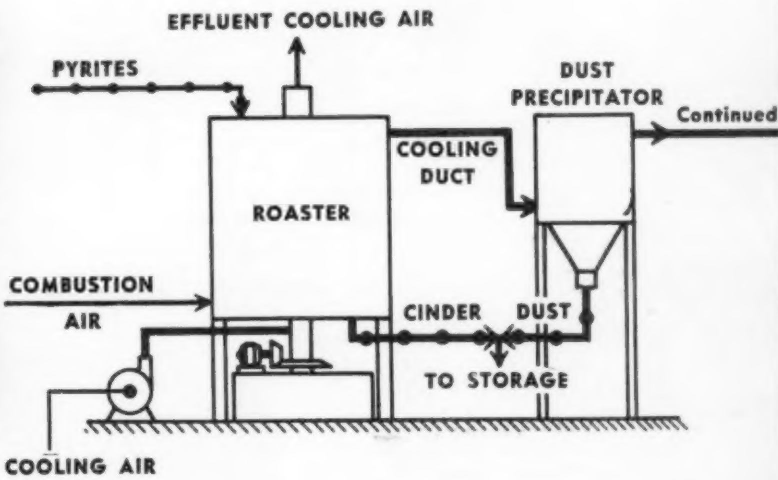
Brimstone is the leading raw material, with iron pyrite a poor second. Material quantities of acid are also made, however, from the roasting of zinc and other sulphur-bearing ores in connection with smelting operations. Further amounts are produced from spent oxides, hydrogen sulphide from refinery gases and other sources, and by decomposition of various otherwise waste acid sludges and spent acids.

While radically different types of contact plants are required according to the raw material used, the product from either type is of high strength and usually of extremely high quality. When brimstone is used, the modern plant is simple to operate and of comparatively low first cost. For most of the other raw materials a plant of much higher first cost is necessary, although its operation remains simple.

The flowsheet depicts a contact plant of the type used where pyrite is the raw material. The photographs are from plants designed by the Monsanto Chemical Co. and built by the Leonard Construction Co.

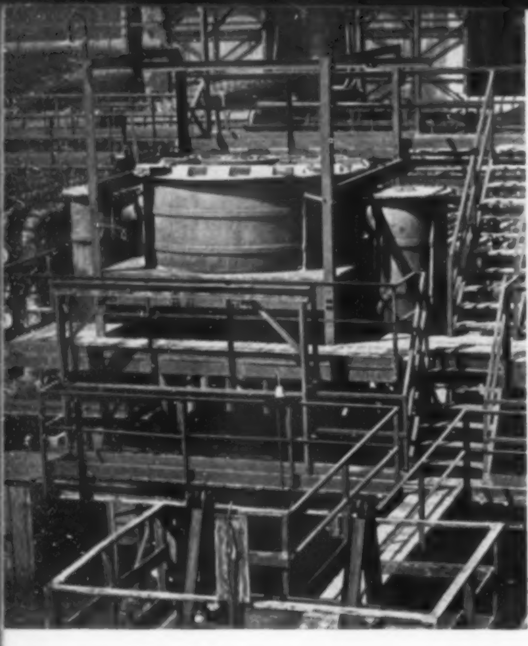


When sulphur-bearing ores, such as iron or zinc sulphides, are used for sulphuric acid manufacture, the sulphur is eliminated from the ore usually by means of multiple-hearth roasters, of which one type is the Herreshoff roaster shown above

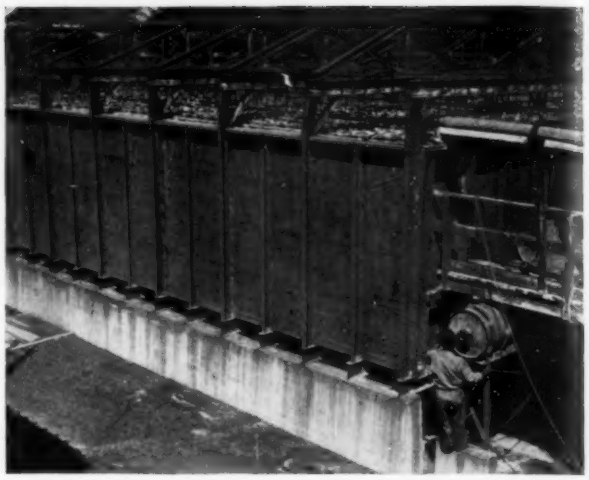



Dependent on the character of the ore and of the roaster employed, varying quantities of dust escape from the roaster into the $SO_2$ gases. Steel firebrick-lined, electrostatic precipitators, operating at temperatures of approximately 400 deg. C. are commonly used for effective removal of dust from the gases

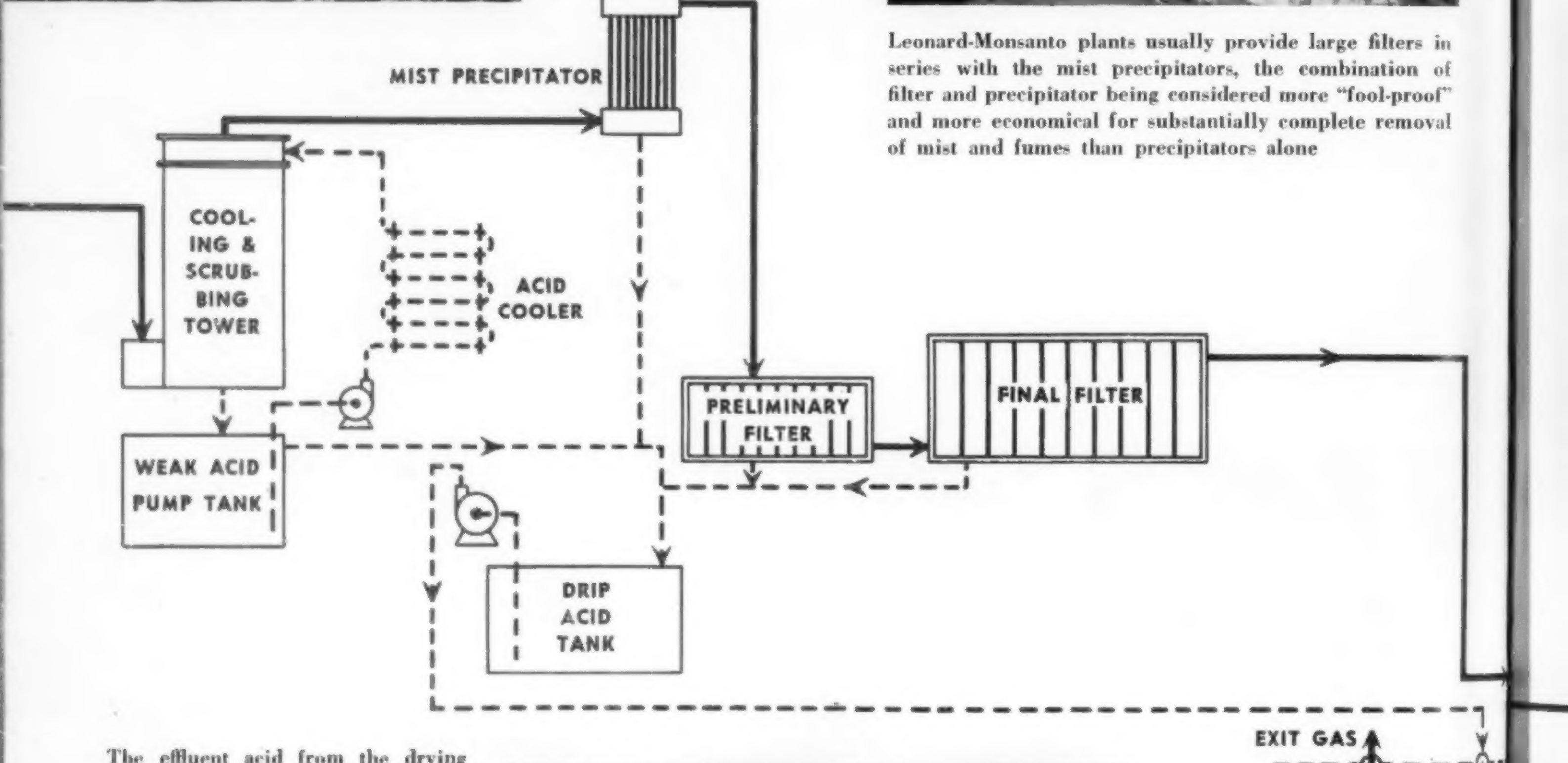
LEGEND:
AIR OR GAS
ACID OR WATER
SOLIDS



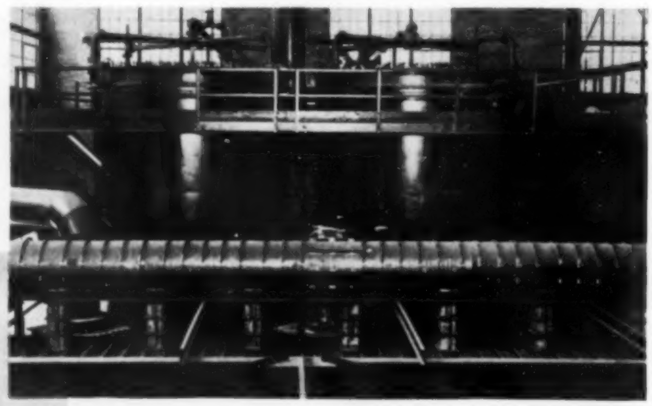
After leaving the dust precipitator, the gases are cooled substantially to atmospheric temperature and then are usually passed through electrostatic precipitators, built of lead, to remove acid mist and metallic fumes

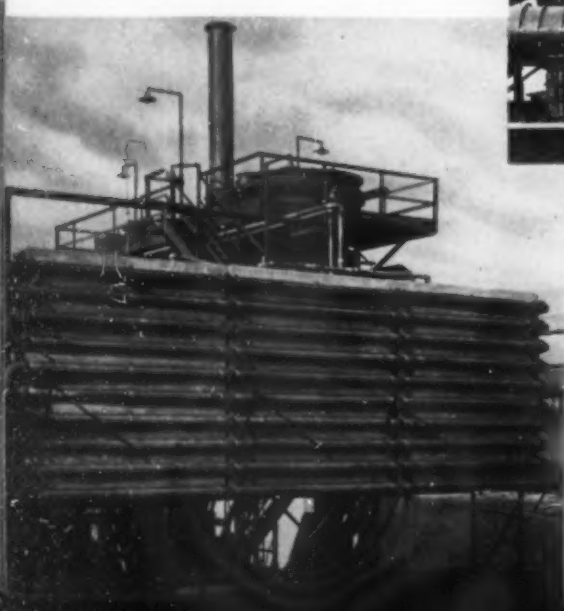


Leonard-Monsanto plants usually provide large filters in series with the mist precipitators, the combination of filter and precipitator being considered more "fool-proof" and more economical for substantially complete removal of mist and fumes than precipitators alone




The effluent acid from the drying and absorbing towers is quite hot and before admitting it again to the towers, it is cooled in cast iron coolers of the type shown. This construction permits ready detection of any leakage and facilitates cleaning when cooling water of inferior quality is used

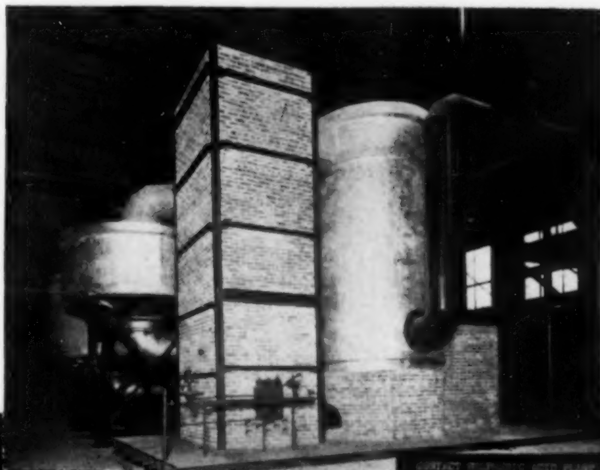


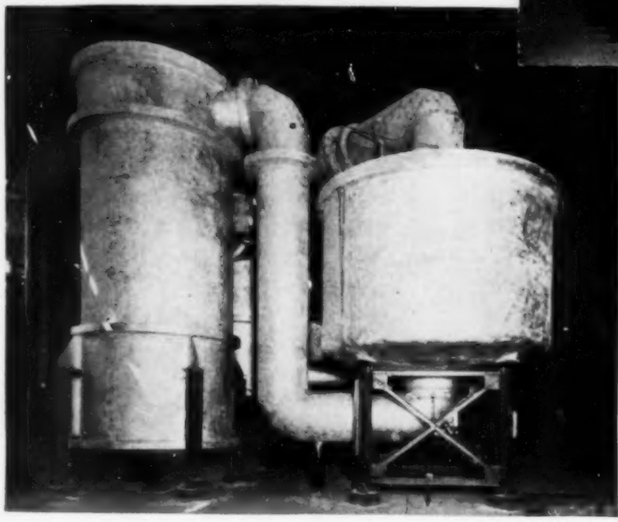


After leaving the filters, the gases are dried in a packed tower through which 66 deg. Bé acid is circulated. Similarly, after the $SO_2$ has been converted to $SO_3$, the $SO_3$ is removed in a packed tower through which 98-99 per cent acid is circulated. Except for type of packing, both towers are of identical construction

A Chem&Met PICTURED FLOW SHEET

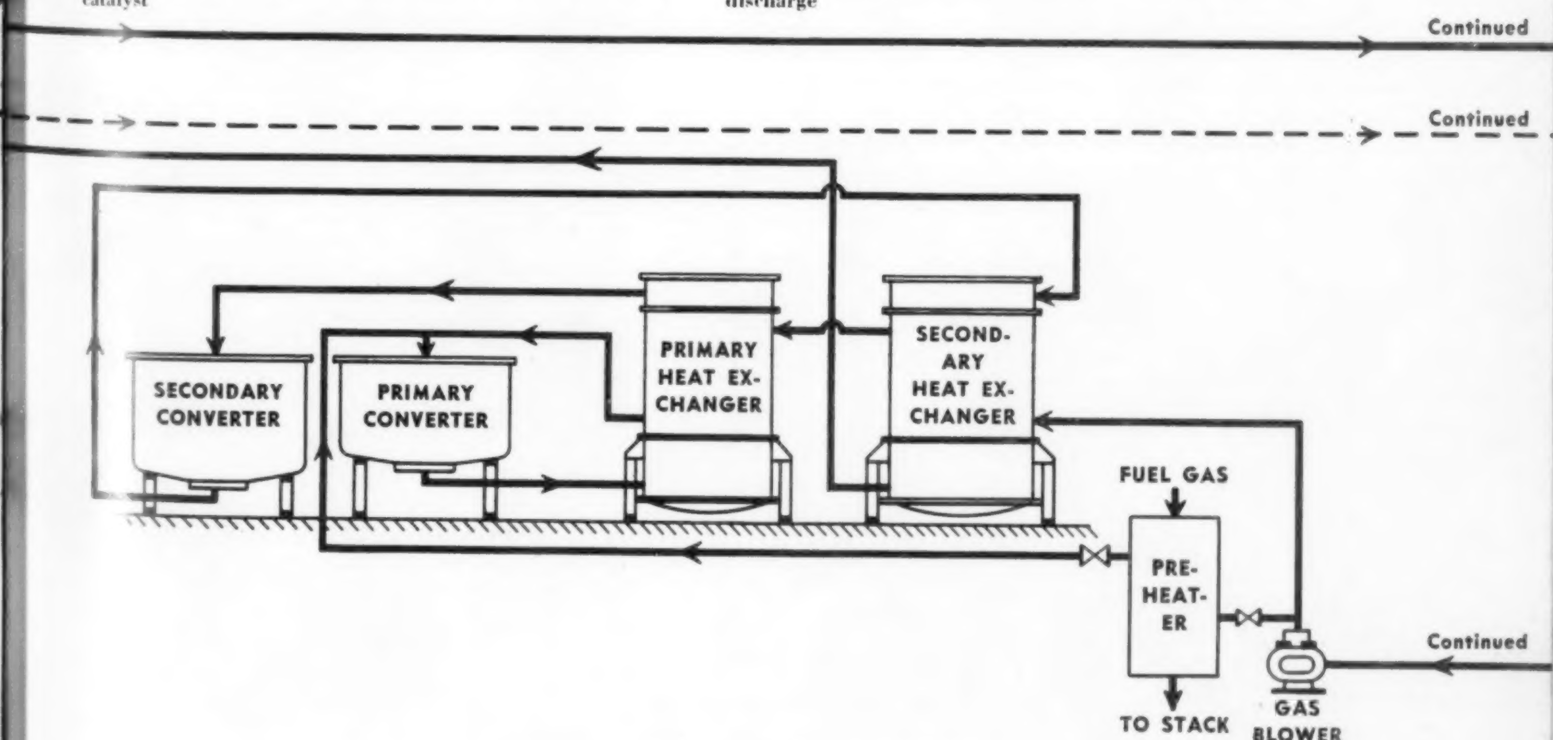
Gas from the blower enters heat exchangers and is heated to about 400 deg. C. before it enters the converters in which Monsanto vanadium catalyst is used. The hot $SO_3$ gases are utilized in the heat exchangers to preheat the cold $SO_2$ gases. Conversion efficiencies of 96-98 per cent are obtained. The cooled $SO_3$ gases pass to the absorbing tower.



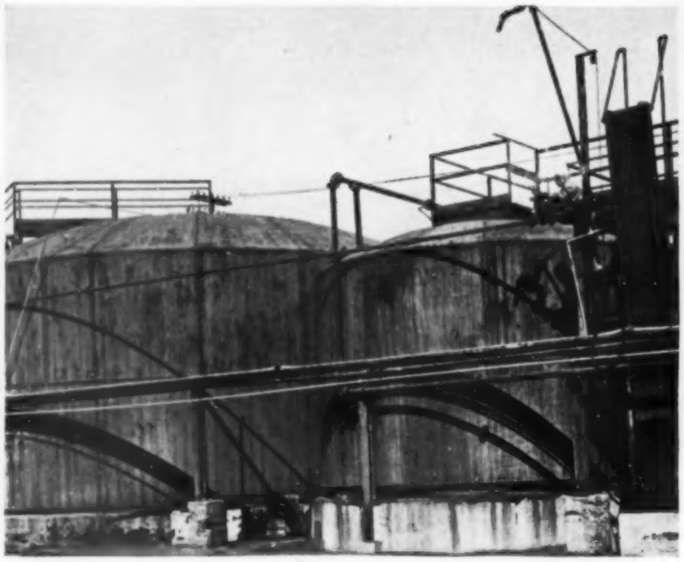


Another view of the secondary converter and heat exchanger. In the Monsanto system about 80 per cent of the conversion takes place in the primary converter with 30 per cent of the catalyst. The remaining conversion is in the secondary converter with 70 per cent of the catalyst

The gas leaving the drying tower enters a blower which may be of the Roots Connersville type, as shown, or of the centrifugal positive-pressure type. The entire system up to the blower is under suction but thereafter is under a pressure usually not in excess of 24 ounces at the blower discharge

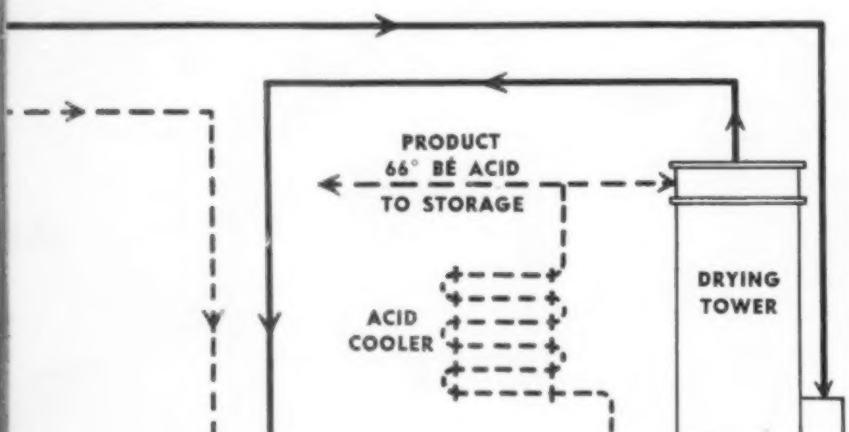


For L.C.L. shipments, 13 gal. glass carboys and 55 or 110 gal. steel drums are used



The product, 98-99 per cent acid from the absorbing tower, either as such or after dilution to 66 deg. or 60 deg. Bé, flows to steel storage tanks. Acids of these strengths, when properly cooled, are not unduly corrosive to steel. Pipe lines for long life are always built of cast iron, although steel has a reasonable life in such service

Steel tank cars are used for the commercial grades of sulphuric acid. For acid of electrolyte grade, which is made by the addition of water to the product 98-99 per cent acid, lead-lined cars are occasionally used



# Recent Trends in Water Treatment

*Use of sulphur compounds in the treatment of water, long extensively practiced in clarification and purification, is increasing rapidly in a number of other processes as well. At present in the United States alone the use of sulphur compounds in water treatment represents a consumption of more than 10,000 tons of sulphur per year.*


SHEPPARD T. POWELL
*Chemical Engineer, Baltimore, Md.*

*and*

LEWIS V. CARPENTER
LLOYD R. SETTER
JOHN J. COATES

*Respectively, Professor of Sanitary Engineering, Assistant Professor of Sanitary Chemistry and Biology, and Research Fellow, New York University New York, N. Y.*


AMONG sulphur compounds in water treatment, sulphur dioxide. the sulphates of aluminum, ferric and ferrous iron, copper, ammonium and hydrogen are the most widely used. Sulphuric acid is used most frequently for adjusting the pH of coagulation to the low value required for optimum color removal with minimum coagulant dose. The sulphate of aluminum (alum) still remains the most popular and economical coagulant for general purposes. Schwartz[1] reports the advantages which may be gained by the use of ferric sulphate and lime for the removal of soluble silica from water. The sulphate of copper is a favorite algicide while ammonium sulphate is frequently utilized in chloramine disinfection. Sulphurous acid has been used for pH adjustment in the removal of color from water[2], as a method of cleaning sand filters[3], and as a dechlorinating agent[4].

The more recently developed processes involving sulphur compounds which are discussed below include: (1) Preparation of coagulants; (2) removal of color and turbidity; (3) removal of silica; (4) sand cleaning; (5) taste and odor control; and (6) deoxygenation.

### Preparation of Coagulants

Many plants employing aluminum sulphate for coagulation have found it economical to buy the raw materials and prepare the coagulant at the point of use. Alum may be prepared by the reaction between sulphuric acid and a suitable aluminum ore such as bauxite. At least ten municipal water departments prepare the primary chemical coagulant from bauxite[5].

Ferric sulphate for coagulation has but recently been made available to the field of water treatment. It is particularly adaptable because of its wide coagulating range and has already found application in the removal of color, manganese[6], and silica.

Ferric sulphate may be bought commercially or made at the point of use by the interaction of scrap iron or ferrous sulphate (copperas), air, sulphur dioxide and water. The preparation of the coagulant in this manner minimizes the necessity for handling corrosive or deliquescent chemicals. Copperas, in particular, is non-corrosive and may be accurately proportioned in most dry feed machines. The copperas when treated with $SO_2$ and air yields a ferric sulphate solution of desired strength and quantity, in which the coagulant remains soluble when added to the water to be treated. On the other hand, most ferric salts are corrosive and difficult to handle with a dry feed machine or frequently inefficient owing to the slow rate of solution.

Much of the development of ferric sulphate production utilizing $SO_2$ is the result of the investigations of Wartman and Keyes[7] and Lyles[8]. The ferric sulphate is prepared by bubbling gas mixtures such as are obtained from a sulphur burner and which contain sulphur dioxide and oxygen, through a tower packed with scrap iron or ferrous sulphate and water.* When scrap iron is used the solution of copperas formed in the first tower is transferred to a second and further oxidized with oxygen from the atmosphere and sulphur dioxide. The result is the formation of ferric sulphate and sulphuric acid according to the reactions:

$$2\,FeSO_4 + SO_2 + O_2 = Fe_2(SO_4)_3$$
$$SO_2 + \tfrac{1}{2}\,O_2 \div H_2O = H_2SO_4$$

Laboratory experiments* indicate the necessity of adding the gas mixture as a stream of fine bubbles to prevent a too rapid passage of the gas through the tower and a large loss of sulphur dioxide.

### Removal of Color and Turbidity

Substantial reduction in chemical costs can be achieved in the coagulation of color and turbidity if inexpensive and efficient acids are utilized

* Preparation of ferric sulphate by this process in the laboratory employed a glass tower, 36 in. high and 1⅞ in. in diameter, having a total volume of 1,630 ml. The gas mixture was introduced at the bottom of this tower, passed through a diffuser set in a rubber stopper and the excess gas was allowed to escape at the top. After trials had been made of various systems of introducing the gas mixture in such a way as to get very fine bubbles, it was decided to use a Jena glass immersion filter tube of medium porosity as the diffuser.

The ferrous sulphate used as the source of iron was a commercial copperas analyzing 22.35 per cent ferrous iron, 0.18 per cent ferric iron and having a formula weight of 248 grams, corresponding to the formula $FeSO_4 \cdot 5.33\,H_2O$. The source of sulphur dioxide was a cylinder of the compressed gas. The sulphur dioxide from the com-

*(Footnote cont. on following page)*

to adjust the pH of floc formation. Moderately alkaline and non-alkaline turbid and, more especially, colored waters respond very well to such treatment. Certain turbid waters having high alkalinity require such large amounts of acid that coagulation at a higher pH value and at the expense of a large dose of trivalent coagulant may be more economical. Colored waters, however, even if highly alkaline, frequently do not respond to coagulation at high pH values and require large coagulant doses if acid adjuncts are not used.

In general, the lower the dose of trivalent cation coagulant, the lower the iso-electric pH or optimum point of coagulation. This remains true until at very low pH values the resultant floc becomes so fragile that it disperses due to slight mechanical shearing stresses such as may be present in flumes or on sand filters.

The adoption of an acid for pH adjustment in the coagulation of a water will depend primarily on economical and handling factors. Sulphuric acid has been utilized but, although inexpensive, handling and feeding difficulties were heretofore serious drawbacks.

Trends indicate that the recent development of automatic sulphur burners having accurate control over a wide range of feed will furnish cheap acids (either sulphurous or sulphuric) with little transportation, storage, handling or feeding difficulties. In poorly buffered waters, it may be advantageous to use sulphurous acid for pH adjustment due to its less intense acidic character.

A highly colored water at Tampa, Florida, is successfully treated with alum and sulphurous acid generated in a sulphur burner with substantial reduction in chemical costs[8].

Experiments conducted at New York University Sanitary Engineering Laboratory indicated that sulphurous acid was equally as effective as the other mineral acids for pH adustment in the ferric sulphate, chlorinated copperas and alum coagulation of a moderately alkaline colored water. Considerable reduction of coagulant dose could be achieved with the aid of acids. To reduce the color of the water from 250 to 25 p.p.m., 11 grains per gal. of alum was required, whereas, upon the addition of 3 grains per gal. of $H_2SO_4$, only 5 grains per gal. of alum was necessary. With the addition of 2 grains per gal. of $SO_2$, only 7 grains per gal. of alum was required, to reduce the color from 250 to 15 p.p.m.

Further developments in the simplicity and compactness of design and ease of operation and control of sulphur burners should demand major consideration for improving the coagulation process of water treatment.

### Removal of Silica

The difficulties resulting from the presence of silica or silicates in water to be used in many treatment processes has but recently become recognized. The presence of silica in boiler feed water is particularly undesirable since the scale which it forms is very hard and adherent to the boiler surfaces. Silica removal has become a steam power problem of paramount importance since the introduction of high pressure boiler plants, which are especially sensitive to scale formation and for whose operation clean metal surfaces are imperative.

Scale deposits cause boiler inefficiencies on account of increased heat resistance and overheating of boiler tubes, resulting in breakdowns. The deposition of even small amounts of silica on turbine blades through "carryover" in the steam results in greatly decreased turbine efficiencies. About the only feasible method of removing such scale is to dismantle the equipment completely and remove the incrustation manually.

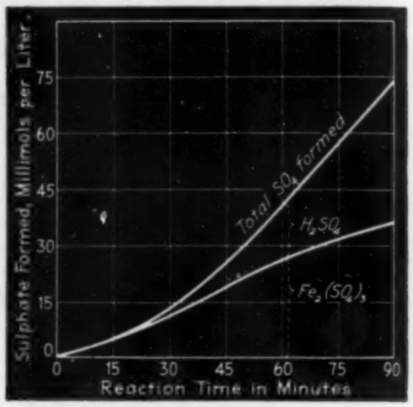



Fig. 1—Formation of ferric sulphate and sulphuric acid from copperas with sulphur dioxide and air

Eberle and Holshauer[9] showed that silicate scale, of all mineral boiler scales, possesses the lowest thermal conductivity coefficient.

Schroeder[10] has demonstrated that silicates play a major role in the phenomenon of intercrystalline cracking of boiler steels. As the result of a number of investigations, he concluded that "practically all intercrystalline cracking, occurring in boilers at 100 lb. pressure or more, involves the combined action of sodium hydroxide and silicate." Straub[11] also has recognized the role played by silica in the embrittlement of boiler steel. However, the reduction of the silica content of boiler feedwater to a point at which it will not take part in the mechanism of embrittlement is not regarded hopefully as a solution of the embrittlement problem, because the quantities which suffice to promote embrittlement can in most cases enter the system as unavoidable contamination. Moreover, it is possible that other agents which exert the same effect can not be eliminated. Nevertheless, the lowering of the silica concentration in boiler feedwater is advantageous for the above reasons.

There are two fundamental methods

*(Footnote cont. from page 481)*

pressed cylinder was admitted into a bottle of 1 liter capacity and stored under a head of about 24 in. of water. From this bottle, the gas was drawn into a gas measuring burette and collected over mercury at atmospheric pressure. From the burette, the gas was delivered to a mixing bottle where it was mixed with the air being added and thence delivered to the reaction tower. By the use of the gas burette, a measured amount of gas could be delivered in any time interval merely by adjusting a pinch clamp on the gas outlet line. The air was delivered to the reaction tower through a 3-liter mixing bottle under 8 lb. per sq. in. pressure. A mercury manometer connected to the mixing bottle provided the measurement of the operating head.

With good diffusion of the gas mixture it was found that a ratio of sulphur dioxide to air of approximately 0.0125 (1.25 per cent $SO_2$ by volume) was apparently most efficient when a solution containing approximately 90 millimols per liter of iron was treated. Under such conditions and with a gas addition rate of 3 liters per minute, 90 minutes treatment resulted in a product containing approximately 75 millimols per liter of ferric iron and 75 millimols per liter of free sulphuric acid. This represented 83 per cent oxidation of the iron and approximately 65 per cent utilization of the added sulphur dioxide.

The addition of small amounts of manganous iron to the original iron solution increased the utilization of sulphur dioxide, presumably due to its catalytic activity in the oxidation of sulphite to sulphate by oxygen.

An example of the rate of ferrous sulphate oxidation or ferric sulphate formation and the formation of free sulphuric acid is shown in Fig. 1. The initial iron content was 94.4 millimols per liter of $FeSO_4$ and 2.7 millimols per liter of $Fe_2(SO_4)_3$. Treatment of 850 ml. with an air mixture containing 1.06 per cent sulphur dioxide at a rate of 2.86 liters per minute for 1½ hours indicated a 76.5 per cent oxidation of ferrous to ferric iron. The total sulphate formed during each interval of time indicates that after a certain concentration density of ferric ion is reached, the quantity of sulphur dioxide which is oxidized to $SO_3$ increases so that a high percentage of sulphur dioxide appears as sulphuric acid.

of preventing the formation of silicate scale: (1) Through a suitable physical-chemical treatment of the boiler water *in situ;* and (2) by removing the silica from the boiler feed water. While treatment of the boiler water may in some cases prevent the deposition of silicate scale, the only complete answer to the problem is to remove the silica before the water enters the boiler.

Stumper[12] showed that of the total amount of silica normally present in natural waters, only 2.5 to 20 per cent is colloidally dispersed. The condition in which silica exists in water is largely dependent upon the hydrogen-ion concentration. In natural waters (pH 6–8) there presumably exist transformation forms of simple molecules, stable in the acid region, and mono-molecular silicic acid, of which a portion exists in the colloidal state. In boiler water, which is frequently very alkaline, extending into a pH region of 12, an equilibrium exists between the mono- and di-silicic acids. The displacement effect of inorganic salts on this equilibrium is recognized but not completely understood.

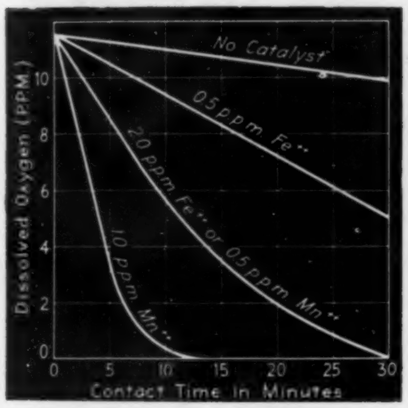



Fig. 2—Effect of ferrous and manganous ion on tap water deoxygenation by sulphur dioxide treatment

#### Ferric Sulphate Process

Recently, Schwartz[1] reported that coagulation with ferric sulphate was a very effective process for removing silica from water. Although apparently ineffective when carried out at an acid pH, coagulation with ferric sulphate resulted in excellent silica removal when the pH was raised to about 9.0 with lime. Investigations were made with a water having an initial soluble concentration of about 7.0 p.p.m. $SiO_2$. Residual silica concentrations as low as 2.0 p.p.m. were obtained upon treatment with approximately 75 p.p.m. $Fe_2(SO_4)_3$ at pH values of 8.5 to 9.5. The process was also quite effective at elevated temperatures although a decreased efficiency of a given dose of ferric sulphate was noticed.

Coagulation jar tests performed at the New York University Sanitary Engineering Laboratory indicated that the silica content of Mississippi River water ($SiO_2$, 2.0 p.p.m.) could be lowered to 0.5 p.p.m. This low value could be achieved only if the water were first acidified to a pH of 3.5 to 4.0 with ferric sulphate-sulphuric acid solution and then after 30 minutes reaction time, alkalinized with lime to a pH above 7.5. Somewhat poorer removal of silica was obtained if either coagulant was used individually, or the two chemicals were added simultaneously, or the pH after acid-iron treatment was not below 4.0. Similarly poor results were obtained (residual $SiO_2$, 1.5 p.p.m.) if the pH upon alkalinization did not reach at least 7.5.

It appeared quite definite that soluble trivalent cations and the acidic character of the water at pH less than 4.0 were necessary for maximum removal of silica obtained by alkalinization with lime to a pH range of 7.5 to 9.5.

#### Sand Cleaning

Sand cleaning becomes an important consideration in many water treatment plants. In general, there are two types of growth which give rise to "mudballs," short circuiting and general sand filtration inefficiency. One type is mineral incrustation, accentuated in water softening plants. The sand grains are primarily coated with semi-soluble calcium, magnesium, manganese and iron compounds which form a cement bond between adjacent sand grains. The other type is organic in nature, probably caused by aerobic biological growths which coat the sand grains and cause them to adhere to each other.

The mechanical action of backwashing a filter is frequently insufficient to rupture these formations, and if more severe mechanical action is not instigated, the growths or mudballs will cause clogging, short filter runs, excessive velocities through the sand, increased turbidity of filtered water, and general inefficiency. The mudball formations are frequently carried deep into the gravel strata of the bed so that manual handling of all filter media during the mechanical and chemical cleaning has to be undertaken. Sodium hydroxide (45 per cent solution) and sulphuric acid (12 per cent solution) are chemical cleaning agents which have been used[13]. Mudballs caused by organic growths have been destroyed by taking the filter out of service for one or two weeks before thorough backwashing. The prevailing anaerobic conditions which resulted caused the disintegration of the aerobic biological slime.

Recent field and laboratory experiments have indicated that sulphur dioxide has possibilities as an effective and inexpensive agent for sand cleaning *in situ*[8, 14]. The advantages of sulphur dioxide are: availability at a reasonable cost, simplicity of application, low labor cost, and a less hazardous treatment.

Experiments conducted at the New York University Sanitary Engineering Laboratory indicated that sulphur dioxide in 2 to 5 per cent aqueous solution was effective for certain types of sand incrustation. Mineral incrustants composed primarily of calcium and magnesium carbonate responded readily to the treatment with copious frothing in the absence of a defrothing agent. Mineral incrustants high in manganese were quite amenable to sulphur dioxide treatment. Incrustants having considerable iron and aluminum silicates responded least effectively to sulphur dioxide. However, this type of incrustant would be least troublesome in filter operation. Organic mudballs were readily disintegrated with 1 or 2 per cent sulphur dioxide after being in transit to the laboratory in jars for one to five days. Apparently the low oxidation reduction potential of sulphur dioxide accomplishes the same dispersion effect on organic growths as does anaerobic decomposition. In the case of one organically coated sand, anaerobic treatment accelerated with 200 p.p.m. starch was less effective than 1 per cent sulphur dioxide.

Treatment with sulphur dioxide added as a gas either from cylinders or from a sulphur burner, depending upon the concentration desired, affords an inexpensive, rapid and flexible method that can be used for cleaning filter media.

#### Taste and Odor Control

New impetus has been given to the use of sulphur compounds for dechlorination following the recent develop-

ments for superchlorination. Many substances, particularly those containing the phenolic group, react with chlorine to form chloro-substituted compounds, such as chlorophenol, which impart a very disagreeable taste to water. In the presence of an appreciable excess of chlorine, however, a further reaction (presumably oxidation) destroys the chloro-organic odors and tastes so that the water becomes odorless and tasteless upon dechlorination.

For dechlorination, sulphur dioxide, sodium sulphite, bisulphite, and thiosulphate have been successfully used, with the former by far the most common. Sulphur dioxide gas may be obtained from a sulphur burner or from cylinders of the compressed gas. It may be added through machines similar to those used for the addition of chlorine.

Toronto, Ontario[4], has used superchlorination followed by sulphur dioxide treatment for controlling severe medicinal tastes. From 6 to 10 lb. of chlorine per million Imperial gallons (0.6–1.0 p.p.m.) is added with a contact period of from 1 to 1.5 hours with the subsequent addition of from 2.75 to 6.25 lb. of sulphur dioxide per million Imperial gallons (0.275–0.625 p.p.m. This latter quantity represents about 25 per cent in excess of the theoretical. With cold water conditions this excess may be as much as 50 per cent.

According to Faber[15] ten municipalities have adopted the process of superchlorination followed by dechlorination. Glencoe, Ill.[16], has been using superchlorination followed by dechlorination with sodium bisulphite for taste destruction. Hale[17] successfully overcame tastes from gasoline leaching into wells by superchlorination followed by sulphur dioxide treatment. He has also employed the same process for the destruction of iron bacteria. Brown[18] found that excess chlorination followed by dechlorination with sulphur dioxide gave the best results in controlling the growth of crenothrix.

Superchlorination affords a simple and relatively inexpensive method of destroying tastes and odors and at the same time assures a completely disinfected water. Many of the former discrepancies in reported results are being explained by experimentation and there seems little doubt but that the future will see an increased use of this process.

Sulphur dioxide, by virtue of its ease in preparation, handling, feeding, and control, appears to be an ideal agent for destroying the chlorine taste after superchlorination.

### Deoxygenation

Of the many factors contributing to the corrosion of metal in hot and cold water systems, it is known that the presence of oxygen is extremely important. Hence, deoxygenation is widely practiced particularly in industrial water treatment. One of the newer methods is the use of reducing agents to react with the dissolved oxygen. Sodium sulphite[19], for example, is widely used in the deoxygenation of boiler feed water. Sodium sulphite reacts with oxygen to form sodium sulphate, the reaction being very rapid at the elevated temperatures found in boilers. Sulphur dioxide may be used as a substitute for sodium sulphite in an alkaline water.

That deoxygenation has applicability in cold water systems is exemplified by the experience of Powell[20] who reported on the deoxygenation of a water supply carried in a nine-mile steel pipe line. The line had suffered a large loss in capacity through tuberculation and pitting. After cleaning the line, a deoxygenation process was installed whereby the remaining 5 per cent of the dissolved oxygen from a mechanical deaerator was removed with sodium sulphite. This deoxygenation was so successful that subsequently only a minor loss in the capacity of the conduit was noticed and the growth of rust tubercules was practically eliminated.

Deoxygenation in the cold with sulphur dioxide, for example, is limited by the fact that the oxidation reaction is very slow at low temperatures. Unless a considerable contact period is allowed, little deoxygenation will occur. Studies of this reaction were made at the New York University Sanitary Engineering Laboratory to determine how the velocity of the reaction could be increased. It was found that the rate of the reaction was, to a great extent, dependent upon the hydrogen-ion concentration, temperature, and the presence of catalysts. The reaction proceeded much more rapidly at pH values.

The effect of catalysts on deoxygenation of water at laboratory temperatures was studied. New York City tap water was treated with a fresh solution of sulphurous acid sufficient just to destroy the predetermined dissolved oxygen content. Residual sulphite tests were made every 15 minutes on completely filled 250 ml. bottles of water containing varying quantities of catalyst.

Manganous sulphate and ferrous sulphate appeared most promising and a summary of five typical sets of results is presented in Fig. 2. The results show that small amounts of catalysts have a major effect on the speed of reduction of oxygen by sulphur dioxide. In the tap water to which catalysts were not added deoxygenation was only 85 per cent complete in 60 minutes, whereas in the presence of 2 p.p.m. manganese ion complete deoxygenation was effected in less than 10 minutes reaction.

In conclusion the authors wish to acknowledge the assistance of the Freeport Sulphur Co., sponsor of the fellowship at New York University which has been conducting the investigations discussed here; and to express their appreciation for the help afforded by D. B. Mason, technical director of the company.

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# Chemical Engineering Opportunities

***If you question the value of a chemical engineering education you should not miss what Mr. Sprague has to say regarding the growing recognition of the value of this training for the fields of sales and distribution, and finance, as well as, production, and research and development.***

**PAUL E. SPRAGUE**

*He started with the Glidden Co., Cleveland, in 1915 immediately after obtaining B.Ch.E. and M.S. degrees at Ohio State University. He has been employed by that company, in various capacities, and at present is Vice-President in charge of sales of pigment, metal, chemical and soybean products.*

ANY DISCUSSION of accomplishment by a group of men in business or industry or any other enterprise must be prefaced by recognition of the fact that there is that characteristic of aggressive personality about some individuals that results in carrying them forward no matter in what activity they engage and no matter what preparatory education they may have had. It is from among men such as these that the outstanding leaders may be expected to emerge.

The comments in this discussion relate to that great body of young men of average ability, average personality and average opportunity—the ordinary college man seeking a career.

Men who seek employment and desire to develop careers in industry and many of the professions will find their activity usually falls into one of four rather broad classifications which will be described as manufacturing, research and control, sales and distribution, and accounting, credit and finance. There is also a fifth field of executive management, but it is not included because men seldom seek or are qualified to enter that field until they have demonstrated some special ability in one of the other four.

So many men with chemical engineering training can and have achieved success that thought has been stimulated as to the reasons therefor. In the first place it will be readily conceded that the past two decades have seen the greatest development over the whole range of applied chemistry that our country has ever experienced. Of course, outstanding strides have been accomplished in almost all fields of applied technology, but this 20-year period must be recognized as one affording leadership in large development to the chemical and other process industries. With this, of course, have matured proportionately more opportunities than ever before for the chemical engineer to take a position of prominence in the purely technical and professional phases of the development. It must be recognized that those who sallied forth from school during this period have really been fortunate and need to be a little cautious about boasting of their progress or of the low unemployment record of the group. It is always easier to swim with than against the current. It can not be denied that this trend in the growth of the chemical process industries has been a factor in explaining the ability of chemical engineers to succeed in other fields, but this trend is not the principal factor in these accomplishments.

One of the major factors is the kind of training received during the several years in college which impressed upon the students that accurate knowledge of facts must be had and that sustained effort must be expended in using it in order to successfully synthesize a chemical or to design and operate a plant. There was no opportunity to spend time with the speculative abstractions of the social sciences, but students were fired with the conviction that through research the horizon of practical knowledge was limitless—if they worked for it. This training sent the young engineers out with the foundation laid for acquiring any additional and supplementary knowledge that most any sort of industrial career would require. In other words, the student received a training that is rarely acquired after leaving school. Upon this firm foundation those who so elected later added an education in cultural subjects or in other fields of activity.

Experience has shown that in this country the administrative and general courses of instruction provide a less effective foundation for a career of accomplishment in industry than do the engineering and more particularly the chemical engineering courses.

In the field of research and control the chemical engineering education has proved an asset and a splendid background for noteworthy accomplishment. Observation does not warrant the statement that it is essential, however, or that it provides any better basis than any other form of technical preparation except that it certainly gives a balanced and practical outlook to a project that in some cases is priceless.

The rapid growth that has taken place in the utilization of chemical engineers in the field of sales and distribution is probably not generally

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known. The Glidden Co. employed the first practical service man to supplement the salesman in selling and getting results with industrial application of paints and varnishes, 19 years ago. Today the service man is a graduate technologist, and there is nothiing better than a chemical engineering training for this type of work. Its importance in the field of distribution of raw materials, semi-finished products and intermediates has grown so fast that many sales managers now require a chemical engineering training as a prerequisite for a salesman. The chemical engineering graduate who will add to his college training the cultivation of those social graces that produce a good personality and will cultivate the ability to think on his feet can soon name his own price in almost any sales organization in the industrial field. The technically trained man is the salesman and director of sales of the next decade.

In the field of finance a chemical engineering training is useful. This type of education supplemented by outside study of sufficient extent to warrant a CPA rating provides a valuable and still rarely recognized preparatory combination for the function of cost accountant, general auditor, and finally the finance director of the corporation. Men in this field must know the basic process and flow of operation of the business to judge the effects of trends and changes. Those who control capital can employ whatever technical or engineering brains and experience needed. This is true but what happens when the experts differ or bad advice is given? No larger industrial cemeteries exist than the resting places of the billions of capital sunk in promoting unsound projects that were technically impossible from the start but which seemed so good to some honest and well-meaning business man or banker.

The value of the knowledge imparted by the chemical engineering training to the man in the field of finance is not the ability to go out and direct the work but to have enough of that background to enable him to avoid being misled by other technologists and to properly rate and understand a technical report submitted by specialists and upon which appropriation for capital investment is being considered. Of almost equal value is that ability to interpret from one's own knowledge the significance of new technical improvements in competing fields, of patent situations, and of raw material developments which are so frequently the heart of the business in these changing times. In this knowledge and ability lies the advantage responsible for some conspicuous careers in this field.

It is sometimes stated that there are more chemical engineers on their way through school and in industry than there are opportunities for them. In view of the fact that this training equips a man to fill positions outside of the laboratory and plant it is probably not true. This fact should be given emphasis in one of the general chemical engineering courses. While it must be recognized that the past decade has been largely a series of depression years with curtailed industrial operations, there is not the slightest reason to believe that the future does not hold more and greater opportunities. Many social philosophers have bewailed the passing of our frontiers with no new land to be opened for settlement. They forget that research has been steadily rejecting this defeatist attitude and showing that the real frontiers of progress stretch almost to infinity. The amazing recent chemical advances in the field of medicine, nutrition and plastics provide foundations for industries which will certainly in the next two decades parallel the development of the last two.

Chemical engineers are slow to realize the incredible extent to which the advancement of their work influences economic progress or the extent to which some are providing the practical means for multiplying the comforts of life and for creating a desire for more and more. Every time a so-called new discovery becomes a necessity it not only adds constructively to national economy but opens new avenues for achievement to the trained man.

We are told that 100 years ago the average person had about 52 wants, that is, things that were made but which not everyone could afford, among which 16 were considered necessities. Today the wants of our people approximate 500 of which nearly 100 are placed in the category of necessities. Most of these have their roots in chemistry.

In all phases of the enterprises involved in developing, producing and distributing the new raw materials and products of this coming period the chemical engineer will find the opportunity he seeks. He should not hesitate to enter any field of industrial operations. If in hard times he has to start as a clerk, a plant operator or an office boy, he need not be discouraged. He will not long be there.

There is little cause for pessimism in the industrial outlook, and this is synonymous with opportunity for chemical engineers, when we see our own outstanding leaders in industrial management proposing and securing the adoption at the Seventh International Management Congress, held in September, of a creed of management which is in part as follows:

> "We who are responsible for the management of industry in supplying the needs of the public for goods and services and who recognize our obligations to stockholders and employees, believe,
>
> "That we should constantly seek to provide better values at lower costs so that more of our people can enjoy more of the world's goods.
>
> "That we should strive to develop the efficiency of industry so as to earn a fair return for the investing public and provide the highest possible reward for the productivity of labor.
>
> "That we should stimulate the genius of science and utilize the methods of research to improve old products and create new ones so as to continuously provide new fields of employment for the present and the coming generations.
>
> "That it is management's duty to be alert to its own shortcomings, to the need for improvement, and to new requirements of society, while always recognizing the responsibility of its trusteeship.
>
> "That business in this country has never been what it could be and never what it yet will be.
>
> "That business, labor, government and agriculture working hand in hand can provide jobs and opportunity for all to work for security without loss of our liberty and rights as free men."

When it is found that men are orienting their thinking around the concept of trusteeship and public responsibility in connection with their exercise of authority in industry we are on the bedrock of an expanding future.

In conclusion, it must be understood that the realization of these things rests upon a solid bedrock of a free society and a free competitive system wherein men will be able to realize rewards commensurate with their efforts and preparation. Such a society and such a system we have enjoyed in this country in the past and such a system we must guard now as the true road to the "abundant life."

# Factors in Spray Scrubber Design

*Gas scrubbing operations are among the most complex in chemical engineering. Therefore, a sound theoretical basis for design is necessary to avoid the disappointments of cut-and-try methods. Such a basis, simple and accurate in practice, has been established for the Pease-Anthony scrubber, a recently developed type which appears to hold much promise both in gas cleaning and in the recovery of soluble materials.*

**R. V. KLEINSCHMIDT**
*Physicist, Arthur D. Little, Inc.*
*Consulting Engineer*
*Pease-Anthony Equipment Co.*
*Cambridge, Mass.*

PROBABLY no other operation in chemical engineering presents so wide a range of conditions to be met as the removal of dust, fume, fogs and smokes from gas streams. Among the variables presented are wide ranges of gas temperature, pressure and composition, of particle size, density and shape, and of degree of cleaning required. The problem also involves removal of the materials in a form suitable for recovery or disposal.

To attempt to design and predict the performance of a piece of equipment in so wide a field, empirically, would be hopeless, involving actual experience under all possible conditions. A sound theoretical basis for design, checked over a considerable range of conditions, is necessary.

Several attempts have been made to do this for various types of equipment with varying success.[1,2,3] A theoretical treatment involving the flow of gases with suspended particles tends to become complicated and only in the case of a very simple system can we expect to obtain results which are adequate and useful. A striking example of the value of simple theoretical treatment is the electrical precipitator, which, in spite of limitations of cost and size, has attained wide commercial success due to its predictable performance under varying conditions.

Recent tests of a simple type of spray washer which lends itself admirably to theoretical treatment have confirmed the validity of the following theory for this type of equipment.

The geometrical simplicity of the Pease-Anthony scrubber[4,5,6,7,8,9,10] makes the performance of this type of equipment readily predictable from theory. It is the purpose of this paper to show how this is done.

The principle of operation of this scrubber (Fig. 1) consists in causing the gas to be cleaned to rotate rapidly in a cylindrical chamber, forming a suitable spray or fog of fine liquid particles in the gas at the axis of the cylinder, and causing these particles to traverse the gas by the centrifugal force due to the rotation of the gas, until they are finally thrown out on the wall of the chamber. The rotation of the gas is commonly produced by bringing the gas in tangentially near one end with a suitable velocity.

### Scrubber Theory

In order to be able to handle a wide range of conditions with maximum economy, it is necessary to have a number of variable conditions which can be adjusted over a considerable range in order to fit a particular set of conditions. In the present case, these variables are: the length $H$ and diameter $D$ of the cylindrical chamber; the viscosity $\mu$ and entering velocity $V$ of the gases through the tangential inlet of area $A$; the rate of rotation, and the axial component of the velocity; the diameter of the dust particles; that of the liquid particles $d$; the centrifugal force $X$ acting on the liquid particles; the velocity of these particles; and the distance $R$ they travel *relative to the gas* before hitting the wall; the total volume of gas $G$, and of liquid $W$, entering the scrubber in unit time; the total time during which the gas is under treatment in the scrubber; the pressure drop $P$ through the scrubber; and others. Of these only a few may be selected as independent variables, under the control of the designer, the remainder being determined by physical or geometric relations, when the independent variables have been selected.

Perhaps the most obvious set of independent variables is: (1) The quantity of gas to be handled in a single unit; (2) the quantity of scrubbing liquid to be used; (3) the diameter and height of the scrubber; (4) the size of liquid particles to be produced in the spray; and (5) the velocity of the gas in the tangential entrance. The particular conditions to be met commonly include: (1) The total volume of gas to be cleaned; (2) the amount of dust to be removed per cubic foot of gas; (3) the range of particle sizes of the dust; (4) the character of the dust as regards shape of particles and density of material; and (4) the permissible residual dust in the gas. Of the remaining dependent variables, the most important is overall cost or economy of the operation, which depends on the cost of the scrubber, fan for moving the gas, pump for supplying water, means for disposing of the dust caught (either to waste or for recovery as a valuable product), the cost of power for driving the fan and pump, and the cost of any liquid lost by evaporation or otherwise.

We assume that the liquid droplets collide with the dust particles, as the former travel through the gas, and that if the ratio of diameters of the liquid and dust particles is not too

great, the liquid particles will collide with practically all dust particles which are in their paths. It is obvious that fine dust may be carried around large objects by the stream lines of the gas. It is also obvious that if two particles are of comparable size and are approaching each other, they will collide, as there will be very little tendency for a particle to be swept aside by the very fine streamline pattern around a particle of similar size. Between these two extremes there is some region in which the tendency to collide decreases as the approaching particle increases in size.

This region of relative sizes is influenced somewhat by the relative velocity of the particles, the properties of the gas, and the shape and density of the particles, but it has been found that for practical purposes dust particles will be hit by liquid particles which are not larger than 200 times their diameter and that above this size the probability of collision falls off rapidly. We, therefore, assume that any liquid particle will hit all dust particles not smaller than 1/200th of its diameter, that are in its path. [Note: If we wish to be rigorous, we should, perhaps, define the size of a dust particle as the diameter of a spherical liquid drop having the same ratio of mass to surface area as the dust particle. Few commercial dusts are specified accurately enough to warrant this refinement.]

The volume swept by a liquid droplet of diameter $d$ is here defined as the tube of gas whose volume is the cross section of the particle times the distance $R$ it travels with respect to the gas, or $\pi d^2 R/4$. The volume swept by the total quantity of liquid is then the sum of the volumes swept by all the individual droplets into which the given quantity of liquid is divided as spray.

In the type of scrubber under consideration the length of path $R$ of the particles through the gas is approximately the radius of the scrubber, or $D/2$. Since the volume of a liquid particle of diameter $d$ is $\pi d^3/6$, therefore, if $d$ represents the "average" particle diameter, the total number of "average" particles formed from a volume of liquid $W$ is $6W/\pi d^3$, and the total volume swept $S$ is:

$$S = (\pi d^2 D/4\times 2)\,(6W/\pi d^3)$$
$$= 3/4\,(DW)/d \qquad (1)$$

This should bear some relation to the total volume of gas $G$ to be scrubbed. Therefore, the dimensionless group $(D/d)\,(W/G)$ is of importance in determining the efficiency of scrubbing. [Note: In actual computation the spray particles are divided into size groups and the scrubbing efficiency is determined separately for each group.]

If we scrub a certain volume of gas with successive small quantities of spray each succeeding quantity of spray will remove proportionately less of the original dust present since the dust previously removed is no longer available to be hit. The result is that the amount of dust remaining in the gas decreases exponentially as the amount of spray used increases. Thus when the volume swept by spray equals the total volume of gas, the actual effective scrubbing is only 63.2 per cent; with the volume swept twice it is 86.4 per cent; and with it swept three times, 95.0 per cent, etc. The equation expressing this relation is:

$$\text{Efficiency} = 1 - e^{-\frac{3\,DW}{4\,d\,G}} \qquad (2)$$

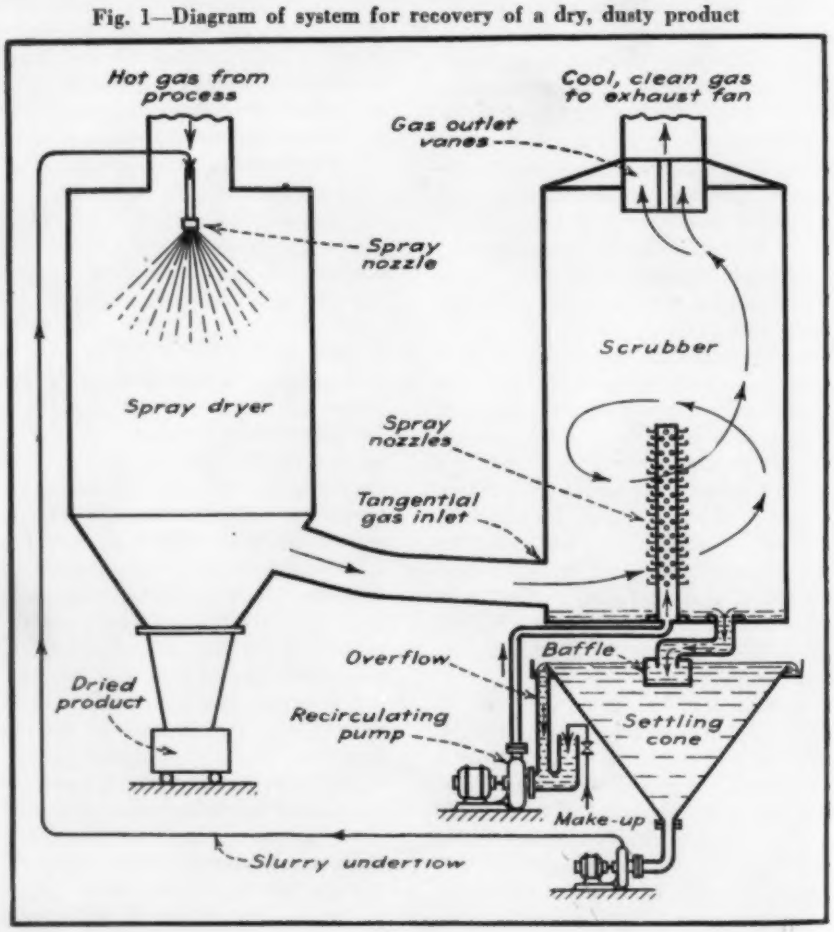
where $e$ is the natural log base.

Harmon[3] has obtained a similar equation for ordinary types of spray towers and packed towers, except that he has a constant added to indicate that the removal of dust will not approach 100 per cent even with an infinite amount of scrubbing, but will approach a definite dust loading. By our theory this means simply that the sprays which he considers are too coarse to hit the finest dust particles, a condition which is generally true of usual types of spray towers that depend on gravity or impingement to eliminate the spray particles from the gas.

In order to prevent carrying spray from the scrubber with the gas, it is necessary that the centrifugal force be sufficient to carry the finest particles of liquid from the sprays to the wall of the scrubber during the time that the gas is passing from the last spray nozzle to the outlet. This involves a knowledge of the velocity distribution in the gas in the scrubber, the motion of small liquid particles through the gas under forces greater than gravity, and the time required for the gas to travel from the last spray nozzle to the exit.

The last mentioned condition is

**Fig. 1—Diagram of system for recovery of a dry, dusty product**



simply the vertical component of velocity, divided into the height of the scrubber above the last spray.

The tangential velocity distribution has been found to be practically that of a rotating solid cylinder except near the shell of the chamber, where friction reduces the velocity somewhat. The height-to-width ratio of the tangential inlet duct also affects the distribution of velocity to a certain extent. It is found, however, that within practical limits of design the velocities are proportional to the inlet velocity and hence the centrifugal forces are proportional to the square of the inlet velocity, and inversely as the diameter of the scrubber. A correction in any specific case must be included for the momentum imparted to the spray particles by the gas. Since this correction may be large, it is reduced so far as possible by pointing the sprays in the direction of the gas rotation. This correction is neglected here. The mean centrifugal force on a liquid particle is then given by the expression $X = V^2/gD$; or since $V = G/A$, then

$$X = G^2/gDA^2 \qquad (3)$$

The motion of the liquid particles under this centrifugal force, which may be of the order of 10 to 100 times gravity, is given by the well known laws of motion of small spheres. So wide a range of spray sizes is required for the various types of dust and fume that many of the particles are too large to obey Stokes' law and their motion involves turbulence. Fig. 2 is a convenient chart giving the radial velocity of spherical particles of various sizes under various forces in air at 60 deg. F. The pressure drop $P$ through the scrubber is almost entirely that due to generating the inlet velocity and is proportional to $V^2/2g$. Combining these factors permits us to obtain the following relation between inlet velocity or pressure drop and height and diameter of the scrubber:

$$H \propto \frac{G\mu}{Pd\,Dg} \propto \frac{G\mu}{V^2dD} \qquad (4)$$

These relations would appear to make possible the direct computation of the design factors for a scrubber for any given service. Thus, starting with the particle size of the dust to be removed, the particle size of the liquid spray required can be obtained as not over 200 times the dust particle size. From this a suitable nozzle and pressure of liquid can be selected. From the given dust loading and degree of cleaning required the percentage efficiency required can be obtained and from this the number of times the gas volume must be swept can be computed by Equation (2). From this the product $DW$ is obtained. The relation between inlet velocity $V$, diameter $D$ and height $H$ is obtained from Equation (4). Then from the power required to generate various inlet velocities, and to pump various amounts of liquid to the pressure needed to produce the required spray particle size, and from the cost of various sizes of scrubbing chambers, the most economical combination can be selected.

### Dimensional Relations

It is, however, often more convenient to design on the basis of some other scrubber already in operation or to pass from a small semi-works model to a larger size, and this can be done with every assurance of success, if the basic theory outlined above is properly applied. A few of the more common cases will be considered by way of illustration. From the equations already given or by direct application of dimensional analysis we obtain the following ratios that must be kept constant in going from one size of scrubber to another if the performance is to remain the same:

$$\frac{DW}{dG},\ \frac{G^2}{2g\,PA^2},\ \text{and}\ \frac{HP\,dDg}{G}$$

From these the following are obtained:

1. Geometrically similar scrubbers:

($P$ = constant, i.e., inlet velocity is constant.)

| | |
|---|---|
| i.e. $A \propto D^2$ | $H \propto D$ |
| Then $G^2/P \propto D^4$ | $W/G \propto d/D$ |
| $G/P \propto D^2$ | $P \propto 1/d$ |
| $G \propto D^2$ | |

2. Constant height, varying diameter, constant pressure drop.

| | |
|---|---|
| i.e. $H$ = const. | $P$ = const. |
| Then $G \propto D$ | $W/G \propto d/D$ |
| $A \propto G$ | |

3. Varying height, constant diameter and inlet area.

| | |
|---|---|
| i.e. $A$ = const. | $D$ = const. |
| Then $P \propto G^2$ | $d$ = const. |
| $G \propto HP$ | |
| $H \propto 1/G$ | |

### Experience with Scrubbers

The foregoing theories have been checked over a considerable range with surprising accuracy. At the Kneeland St. boiler plant of the Boston Edison Co., six scrubbers approximately 10½ ft. in diameter by 20 ft. high are catching powdered fuel fly ash, a large part of which is 3 to 5 microns, with an efficiency slightly better than that predicted by the theory.[6]

A small semi-works unit only 1 ft. in diameter has given "satisfactory clean-up" of a fine chemical fume of less than 1 micron particle diameter, under conditions indicated by the theory. A number of experimental studies have been made which confirm such points as the increasing efficiency resulting from finer atomization of the liquid, the necessity for increasing the height of the scrubber at low inlet velocities, and the ability to catch fine fumes with sufficient quantities of liquid atomized sufficiently finely.

One question which frequently arises concerns the lower limit of particle sizes that can be caught by this type of spray scrubber. It has been shown by Johnstone and the author[7] that this equipment is extremely efficient in absorbing gaseous impurities, such as $SO_2$ from flue gases, even with small amounts of relatively coarse spray. This efficiency is higher than that on fine dust. As we consider dusts or fumes of smaller and smaller particle size, we reach a point at about 0.1 micron where the particles begin to take up molecular motion (Brownian movement), and hence begin to diffuse through the gas due to this motion. Below this size they become more readily caught by the liquid particles

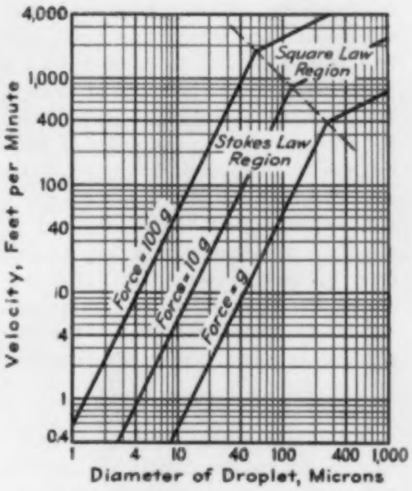



Fig. 2—Velocity of water droplets in air at 60 deg. F. under various centrifugal forces

(if the latter are fine enough), since those particles whose molecular motion brings them into contact with a liquid particle will be caught. We find, therefore, that a particle size of about 0.1 micron, which is the order of magnitude of the particles in cigarette smoke, is the hardest of all to catch, and requires mist of the order of 20 microns in diameter to catch it. This type of mist, however, can be produced by high pressure nozzles and can be adequately handled by the centrifugal action of the spray chamber.

### Uses for the Scrubber

It is obvious that equipment based on this design can have wide application in mechanical, chemical and metallurgical processes. The removal of $SO_2$, already demonstrated as practicable on boiler flue gases, and even more readily adapted to metallurgical gases, represents one end of the gamut. It is hoped that laboratory tests on ammonium sulphite and chloride fumes may soon be supplemented by tests on such chemical problems as acid mists, soda fume, and similar problems in the 0.1 to 1.0 micron range of particle sizes. The large scale work on removal of powdered fuel fly ash from boiler flue gases, which has eight years of successful operating experience behind it, represents operation at maximum economy of both equipment and power on dust in the 1–10 micron range. Coarser dusts, although amenable to cruder methods of treatment, are no obstacle to the operation of this equipment as there is nothing to clog and very little opportunity for erosion. Complete acid-proof construction is not only possible but is normally used on flue gases, the recirculated water being strongly acid.

The question often arises of recovering material in dry form from a hot, fume laden gas. This is readily accomplished by the system which is illustrated in Fig. 1. A preliminary drying chamber dries the effluent from the scrubber system, which may be either a concentrated solution of a soluble fume formed by recirculating the scrubbing liquid, or a sludge of insoluble dust removed from settling cones. In either case, any dust which escapes the drying chamber is removed again in the scrubber. There is certainly no disadvantage in thus cooling and partially saturating the hot gases before scrubbing, although if suitable materials of construction are used, the scrubber will handle gases at any inlet temperature.

This scrubber was originally developed as the simplest and most economical method of removing fine fly ash from boiler flue gases. The present work indicates that without sacrificing its essential simplicity and economy, it has sufficient flexibility in its design elements to handle any dust or fume catching, or gas absorption problem, with any degree of efficiency required. In the field of fine dust collecting it is comparable in efficiency with the wet type electrostatic precipitator, with materially lower investment and operating costs. In the field of absorption, it has demonstrated superiority over all types of packed towers, both in efficiency and in weight and size. A number of interesting applications in the chemical engineering field are now in progress.

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## More on Converter Life

Norman W. Krase, of the Ammonia Department, E. I. du Pont de Nemours & Co., Wilmington, Del., who was formerly in the chemical engineering department of the University of Illinois, has supplied us with the following additional information on the physical properties of the ammonia converter which was described by Wm. L. Edwards on p. 361 of our June 1939 issue, as follows:

"The article by W. L. Edwards in your June issue makes available important data bearing on the life of synthetic ammonia converters. Opportunities for examination of equipment after long periods of severe service are so rare that it is desirable to exhaust the possibilities. It may be of interest, therefore, to record certain additional observations as well as confirmatory results obtained at the University of Illinois on a section of the same ammonia converter adjacent to the one examined by Edwards. This section was cut from the converter at approximately the 'hot point' of the catalyst bed and immediately below the piece described by Edwards.

"Physical properties of the steel were measured on two types of specimens. The major axis of one type was vertical, that of the other type was horizontal. In addition to the properties reported by Edwards, Charpy tests were made on pieces (horizontal axes) cut from the wall at different radii. Results are shown in the table.

| | Before Service | After Service Horizontal | After Service Vertical |
|---|---|---|---|
| Ultimate yield strength, p.s.i. | 82,500 | 85,700 | 82,380 |
| Yield point, p.s.i. | 42,000 | 50,980 | 45,400 |
| Elongation in 2 in., per cent. | 28 | 22.5 | 26.8 |
| Reduction of area, per cent. | 60.6 | 50.5 | 68.2 |
| Brinell hardness number | 170 | | |
| Inside surface | ... | 131 | |
| Outside surface | ... | 178 | |
| Charpy test, ft. lbs. | ... | ... | |
| Near inner surface | ... | 16.9 | |
| Near outer surface | ... | 24.0 | |

"It is noteworthy that Charpy tests show significant variations with position in the wall, increasing approximately 50 per cent from inside to outside. The energy of rupture measured by the Charpy test is not, to my knowledge, a factor usually considered in designs of pressure vessels nor is its relation to other properties clearly understood. Charpy tests on the original steel are not available for comparison. Professor H. F. Moore of the Engineering College, University of Illinois kindly arranged for the carrying out of most of these tests."

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*Correction*—P. C. Kingsbury, of the General Ceramics Co., who supplied the data used in the table of properties of chemical stoneware appearing on page 656 of our November 1938 issue, has called our attention to an editorial error which occurred in transcribing the figure for thermal conductivity. Although labeled "per inch of thickness" this figure, 0.833, is actually for a foot of thickness. The correct figure per inch of thickness is 10.0.

Still more unfortunately the incorrect figure was accepted as fact in a recent article by L. C. Werking (*Chem. & Met.*, June 1939, p. 363), where in a table comparing the thermal conductivities of various materials, the figure was quoted as 0.07 B.t.u. per sq. ft., deg. F., hr. and *foot* of thickness. This figure should have been 0.833 B.t.u. per foot of thickness. Commenting on the correction, Mr. Werking stated that he very much regretted the fact that this figure was one of the few in the table which had not been checked.—Editor.

# Chemical Engineer's BOOKSHELF

## Timely Thoughts on Air Conditioning

### AIR CONDITIONING

HEATING, VENTILATING AND AIR CONDITIONING GUIDE 1939. Vol. 17. Published by American Society of Heating and Ventilating Engineers, New York, N. Y. 1,160 pages including catalog section. Price $5.

SINCE THE FIRST appearance of this annual publication in 1922 its size and completeness have been continually increased. The 1939 edition for example has a data section of 856 pages compared with 840 pages in 1938. An inspection of the tables of contents for the two years reveals little change. Two chapters of the 1938 edition were combined in 1939, and one additional chapter, on heat transfer surface coils, was put in this latest edition. However, one third of the forty-five chapters have been completely revised while another five chapters have been subject to minor revision. Older information which has been retained has been condensed and combined while all new developments of the Society's research laboratory and the cooperating universities have been summarized and added to the new volume. Some users will, doubtless, regret the omission of the self-indexing system used in the 1938 volume.

DESIGN OF INDUSTRIAL EXHAUST SYSTEMS. By *John L. Alden*. Published by The Industrial Press, New York, N. Y. 220 pages. Price $3.

ALTHOUGH IT HAS BEEN treated as an incidental part of most books on ventilation and air conditioning, the question of how to put moving air to work in the conveying of gases, fumes, dusts and other solids has not heretofore received adequate treatment. Mr. Alden corrects this condition in excellent fashion and his little treatise is one that should be a "must" on the shelf of every engineer whose duty it is to design or specify dust and fume removal equipment.

Starting with a good exposition of the flow of fluids, the author launches into discussions of hood forms; the flow of air through hoods; resistance of pipes; piping design; dust separators; low pressure conveyors; exhaust fans; structural details; and field measurements. Many excellent drawings are included, with charts, monographs and tabulations sufficient to permit the solution of most problems.

AIR CONDITIONING. By *Charles A. Fuller* in collaboration with *David Snow*. Published by The Norman W. Henley Publishing Co., New York, N. Y. 577 pages.

Reviewed by *T. R. Olive*

FROM SEVERAL STANDPOINTS this is one of the best books in the rapidly growing library on air conditioning. Not only does the author have what appears to be an exceptionally competent grasp of the subject, but he also has the happy faculty of being able to impart it to others.

Although there is nothing startling in the methods of his approach Mr. Fuller does a good workmanlike job and accomplishes his express intention of producing a book, not too highly technical, yet by no means too elementary for the engineer with an ordinary grasp of mathematics. With a carefully adjusted balance between theory, types of process, methods of calculation and equipment, the book is one which will appeal to the student, the air conditioning user and the engineer-designer alike.

AIR CONDITIONING FOR COMFORT. Third Edition. By *Samuel R. Lewis*. Published by Kieney Publishing Co., Chicago, Ill. 288 pages.

AS THE TITLE STATES, Mr. Lewis' book is concerned primarily with comfort air conditioning and so is of somewhat restricted interest to engineers with industrial air conditioning problems. On the other hand, air conditioning fundamentals are the same whether for comfort or for utilitarian purposes and on that account much of the book will appeal to the engineering reader even though his interests lie solely in the industrial field.

Since the second edition of this work, which we reviewed in 1935, Mr. Lewis has materially improved many of his chapters. For one thing, in his problems he has eliminated approximation methods which tended to become confusing to the engineering reader. For another, he has described much more equipment. Several new chapters have been added including one on noise control, another on instruments.

### A.I.Ch.E. TRANSACTIONS

TRANSACTIONS OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Volume XXXIV. 1938. Published by the American Institute of Chemical Engineers, 29 West 39 St., New York, N. Y. 734 pages. Price, $10.

THE 1938 TRANSACTIONS contains papers read at the meetings held at St. Louis, Mo., November 17–19, 1937; at White Sulphur Springs, W. Va., May 9–11, 1938 and at Philadelphia, Pa., November 9–11, 1938. This volume contains a special report on a standard system of symbols covering unit operations of chemical engineering. Minor changes were made and certain units added to standardize nomenclature in order to avoid confusion and bring it into line with common usage.

The prize winning paper of the annual student competition directed by the Committee on Student Chapters is given in its entirety along with a list of the names of the other five prize winners.

It is interesting to note that the American Institute of Chemical Engineers has now assumed the publication of its own Transactions.

### PLASTICS

PROCESSES AND MACHINERY IN THE PLASTICS INDUSTRY. By *Kurt Brandenburger*. Published by Pitman Publishing Corp., New York, N. Y. 240 pages. Price $6.

THIS BOOK IS a translation of Vols. 1 and 2 of the author's Herstellung und Verarbeitung von Kunstharz—pressmas-

sen, 1st edition, 1934. It is of value to the engineer interested in the molding of phenolic resinoids as it was done at the time the original manuscript was prepared. However, many other resins and plastics are not treated, nor is the production of the phenolic material covered by the author, and since there have been many new developments in molding equipment and processing since this work was prepared, its value is necessarily somewhat limited.

## FLOTATION

PRINCIPLES OF FLOTATION. By *Jan. W. Wark*. Published by Australasian Institute of Mining and Metallurgy, Melbourne, Australia. 346 pages. Price 21 s.

FOR SEVERAL YEARS Dr. Wark has been chief investigator in charge of a flotation research program carried out at the University of Melbourne and financed by a group of Australian nonferrous metal mining companies. The present monograph is a progress report of his results, coupled with a critical commentary on contemporary opinion and theory in the field.

Written from the viewpoint of the physical chemist, the book is by no means a study of current flotation practice. Its appeal is chiefly to the flotation investigator and to the operator whose intellectual curiosity goes beyond the bounds of the immediate job. Dr. Wark has little to say to those who are interested only in mill practice, hook-ups, operating costs and other practical information, but for the man who wants a thorough grounding in this thirty-year-old science, the new monograph should prove a stimulating and provocative study.

FLOTATION PLANT PRACTICE. Third Edition. By *Philip Rabone*. Published by Mining Publications, Ltd., London, England. 184 pages. Price 12s.6d.

FLOTATION PRACTICE has been changing so rapidly that this book is now in its third revised and enlarged edition within the space of six years. Intentionally, the scope has been kept compact and the content as practical as possible. Designed primarily for the metallurgist interested in the concentration of metallic minerals, the book's approach is none the less of considerable use to chemical engineers seeking acquaintance with the theory, equipment and flowsheets employed in non-metallic mineral flotation, despite the fact that only a few of the latter processes are described in detail. This, although it is regrettable, was probably necessitated by the still uncompleted development of many proposed non-metallic flotation applications.

CRYSTALLINE ENZYMES. By *John H. Northrop*. Published by Columbia University Press, New York, N. Y. 176 pages. Price $3.

THE TWELFTH VOLUME of the Columbia Biological Series, "Crystalline Enzymes," contains the results of a series of investigations on the isolation and chemistry of bacteriophage of the proteolytic enzymes carried out in the laboratory of John H. Northrop at The Rockefeller Institute for Medical Research, Princeton, N. J.

Pepsin, trypsin, chymotrypsin, and carboxypeptidase, as well as some of their inactive precursors, have been purified and prepared as crystalline proteins. Bacteriophage has been highly purified but not yet crystallized. Dr. Northrop reviews the previous work on these substances and presents complete details for their preparation. There is a very extensive bibliography.

LEATHER FINISHES. By *J. S. Mudd*. Published by The Chemical Publishing Co., New York, N. Y. 113 pages. Price $4.25.

THE PRIMARY OBJECT of this book is to give the users of all types of finishes information on their composition, the raw materials used in their manufacture and the methods by which they are produced. It gives the finish manufacturers information on the various problems involved in the application of their materials and so assists them in formulation. In addition, the book should not be without interest to certain sections of he paint and pigment industry since the book devotes a chapter to this subject covering such aspects as selective absorption, earth colors, grinding, air flotation, precipitation, etc. Pigment finishes are of utmost importance because of the regularity of color and increased cutting value given the leather.

THE DISEASES OF ELECTRICAL MACHINERY. By *G. W. Stubbings*. Published by The Chemical Publishing Co., New York, N. Y. 219 pages. Price $3.

WRITTEN FOR THE information of electricians, apprentices and power plant engineers who are users of electrical machinery, the object has been to make clear the underlying causes of defects in electrical machinery, as well as to deal with the location and rectification of these defects. The basic principles of electrical machines are briefly reviewed and some simple methods of testing and locating electrical faults are explained.

WELDING HANDBOOK, First Edition. Edited by *W. Sparagen*. Published by American Welding Society, New York, N. Y. 1,211 pages. Price $5.

ALTHOUGH ENTITLED a handbook, this new contribution from the American Welding Society can more accurately be described as an extensive collection of nearly ninety short articles assembled in sixty-one chapters which deal with welding processes, materials and metallurgy, testing, welding applications and critical digests of the welding literature. An idea of the scope of the project is given by the fact that ninety authors contributed, while this work was criticized by 237 reviewers before publication.

The literature of welding has grown with amazing rapidity in recent years. Recognizing this fact, the Society has attempted to digest and gather in one place as much up to date information as possible. Owing to the tremendously broad scope that has been attempted, parts of the book are superficial, but the majority of the authors have done a surprisingly good job in the limited space available. Most engineers who use or specify welding to any considerable extent will find the compendium useful.

DICTIONARY OF SCIENTIFIC TERMS. By *C. M. Bradnell*. Published by Chemical Publishing Co., New York, N. Y. 235 pages. Price $3.

IN ADDITION TO the correct spelling or meaning of words, this book tells in simple language of hormones and vitamins, wave-lengths, size and weight not only of the smaller entities—protons, electrons, and atoms—but also of the larger—the Earth, the Solar System, and the Milky Way. It describes heavy hydrogen, heavy water, and heavy ice plus chemical elements that are changeable into other elements.

ORGANIC SYNTHESIS. By *John R. Johnson*. Published by John Wiley and Sons, Inc., New York, N. Y. 105 pages. Price $1.75.

AN ANNUAL PUBLICATION of satisfactory methods for the preparation of organic chemicals, sub title of this little book, more or less defines its character. There are no introductions nor descriptive matter. Each chapter deals with one compound giving structure, method of analysis, methods of preparation and a few notes plus a good bibliography at the end of each section. The forty or more editors and contributors are made up of many well known names such as that of Dr. V. N. Ipatieff, recently elected to membership in the National Academy of Sciences in recognition of his achievements.

This book should prove a handy little volume for the shelf of any organic chemical laboratcry as well as for students of the subject.

OXIDATION POTENTIALS by *W. Latimer*. Published by Prentice-Hall, Inc., New York, N. Y. 336 pages. Price $3.

CHEMISTRY WILL approach a science rather than an art when the research worker is able to calculate a priori effective reactions and the respective energies involved. Inorganic chemistry, in this respect, has made the greatest strides, and this data is summarized in the present book in terms of the oxidation-reduction potentials, free energies of formation, equilibrium constants, activity coefficients, and entropy values of the various inorganic elements and their compounds.

It is interesting to note that the author introduces a new term called "polar number" to represent the charge on an atom, using the familiar term "valence" to mean the number of bonds which an atom shares with other atoms.

# Nomographic Chart for Temperature Correction of Soda Ash Solution Densities, With Additional Scales for Interconversion of Physical Data

By ERNST BERL
*Research Professor*
*Carnegie Institute of Technology*
*Pittsburg, Pa.*

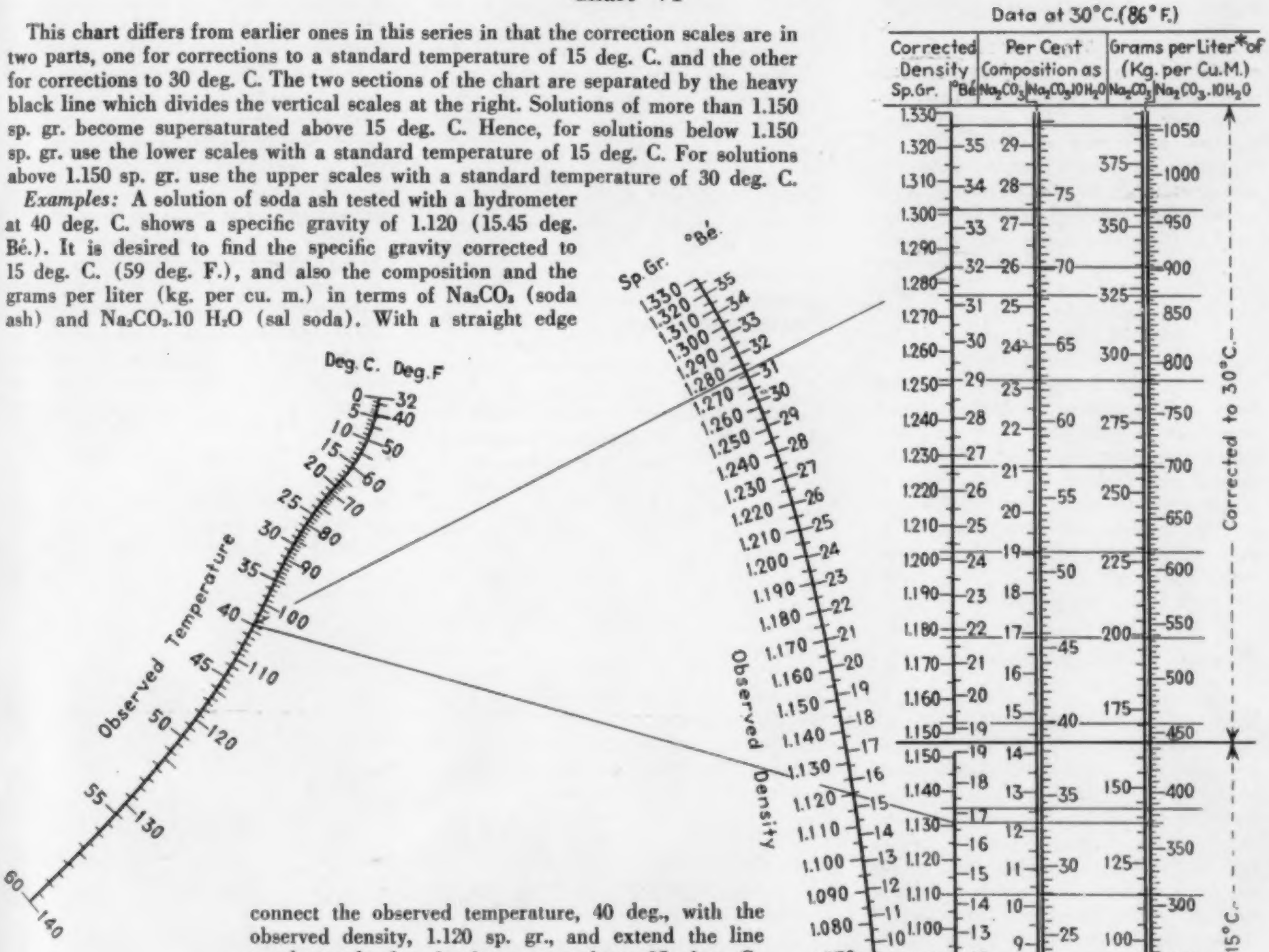
## Chart VI

This chart differs from earlier ones in this series in that the correction scales are in two parts, one for corrections to a standard temperature of 15 deg. C. and the other for corrections to 30 deg. C. The two sections of the chart are separated by the heavy black line which divides the vertical scales at the right. Solutions of more than 1.150 sp. gr. become supersaturated above 15 deg. C. Hence, for solutions below 1.150 sp. gr. use the lower scales with a standard temperature of 15 deg. C. For solutions above 1.150 sp. gr. use the upper scales with a standard temperature of 30 deg. C.

*Examples:* A solution of soda ash tested with a hydrometer at 40 deg. C. shows a specific gravity of 1.120 (15.45 deg. Bé.). It is desired to find the specific gravity corrected to 15 deg. C. (59 deg. F.), and also the composition and the grams per liter (kg. per cu. m.) in terms of $Na_2CO_3$ (soda ash) and $Na_2CO_3.10\ H_2O$ (sal soda). With a straight edge connect the observed temperature, 40 deg., with the observed density, 1.120 sp. gr., and extend the line to the scale for density corrected to 15 deg. C., cutting the latter at 1.131 sp. gr. (16.7 deg. Bé.). To determine the physical properties corresponding to this corrected density, extend a horizontal line from 1.131 to the right. The sample is thus found to contain 12.2 per cent $Na_2CO_3$ and 33.0 per cent $Na_2CO_3.10\ H_2O$. It contains 138 grams per liter (kg. per cu. m.) of $Na_2CO_3$ and 373 grams per liter of $Na_2CO_3.10\ H_2O$.

Another sample of soda ash solution tested with a hydrometer at 40 deg. C. shows a density of 1.277 sp. gr. (31.3 deg. Bé.). By the method shown above, but using the upper section of the vertical scales, the sample corrected to 30 deg. C. is found to have a density of 1.285 sp. gr. (32.0 deg. Bé.). The solution contains 26.0 per cent $Na_2CO_3$ and 70.1 per cent $Na_2CO_3.10\ H_2O$; and 334 grams per liter of $Na_2CO_3$ and 903 grams per liter of $Na_2CO_3.10\ H_2O$.

*Note:* This chart is the sixth of a series translated from a more extended series published in 1930 by Julius Springer of Berlin, under the title of "Nomographic Charts for the Chemical Industry." In the original preparation of these charts Dr. Berl had the assistance of Drs. W. Herbert and W. Wahlig.




* For pounds per cubic foot divide by 16.02.

*Reproduced by permission of Julius Springer, Berlin.*

## Process Equipment NEWS

# Machinery, Materials and Products

### Sulphuric Acid Drum

A TWO-PIECE 55-gal. drum for sulphuric acid service has just been announced by the Pressed Steel Tank Co., Milwaukee, Wis. The drum is constructed from two seamless shells of flange quality steel, joined together by means of a single circumferential weld at the mid-section. The circumferential weld and the side bung weld are made so as to present a smooth drum interior, free from crevices. The rolling hoops are attached by means of separate lugs, welded to the wall of the drum. Top and bottom chimes are reinforced to protect the head. The completed drum is heat treated to improve resistance to acid corrosion. For aqua ammonia shipment, the company has developed a similar drum which, however, is not heat treated. The interior surface is pacified before shipment so as to overcome the possibility of discoloration of the ammonia. Both drums comply with I.C.C. requirements.

### Remote Speed Indicator

FOR USE on its Varidrive motor, U. S. Electrical Motors, Inc., 200 East Slauson Ave., Los Angeles, Calif., has recently developed a new electric remote speed indicator which combines in one unit a simply constructed meter serving as the speed indicator together with a pair of push-buttons for changing the output speed of the unit as desired. Indicators may be calibrated in any units desired by the user. The remote indicator station may be replaced by a single push-button, by automatic control equipment or other devices.

### Double Arm Mixer

A NEW double arm vacuum mixer with only one packing gland has been introduced by the Read Machinery Co., York, Pa., for use in the manufacture of paints, inks, flush colors, plastics, resins and pharmaceutical products. Operating under high vacuum, the machine permits evaporation of moisture or solvents at temperatures below their atmospheric boiling point. Cored mixing arms and a jacket can be provided for the circulation of a temperature controlling medium. A single packing gland is installed where the front arm shaft enters the gear case. Arm shaft seals, quickly removable for cleaning, are installed between the mixing chamber and the vacuum chambers on each arm shaft. These seals hold only the hydrostatic head of material in the bowl and are said to eliminate contamination from oil or foreign materials. Mixers are built in sizes from 2½ to 400 gal. and in any suitable construction material.

### Equipment Briefs

CONTINUING the development of its line of continuous centrifugals, the Bird Machine Co., South Walpole, Mass., is offering a new larger solid-bowl machine which handles from two to four times as much material as the earlier models and yet requires only 10x6 ft. of floor space. The machine operates on the same principles as its smaller prototypes. Its capacity is 10 to 20 tons of solids per hour, depending on the characteristics of the liquor and solids in the feed slurry.

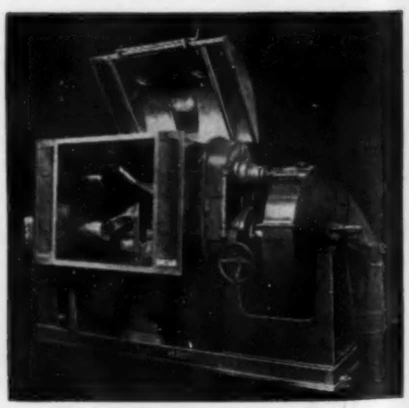
A NEW McCleod type gage for high vacuum measurement, which is readily portable and can be safely carried about without danger of breakage or spilling of mercury, has been put on the market by the F. J. Stokes Machine Co., Olney P. O., Philadelphia, Pa. With the new gage a single reading can be taken in from two to five seconds and continuous readings can be made in rapid succession, simply by turning the gage from a horizontal (evacuated) position to a vertical (reading) position. The instrument is capable of measuring pressures from 0 to 5,000 microns and weighs but 4½ lb., complete with mercury. For permanent installation, it is provided with a swivel bracket and stops so that the gage may be quickly turned from the evacuated to the reading position.

DESPATCH OVEN CO., Minneapolis, Minn., has announced a new indirect air heater which may be gas- or oil-fired and which is said to incorporate many new features, practically eliminating maintenance and parts replacement. The heat exchanger is provided with a heavy duty alloy cast protecting plate which shields the tubes from direct radiant heat. The 88 individual tubes used are staggered to produce the greatest possible wiping action of the air as it passes through the ex-

Speed indicator for Varidrive motor

Hackney two-piece acid drum

Double-arm vacuum mixer



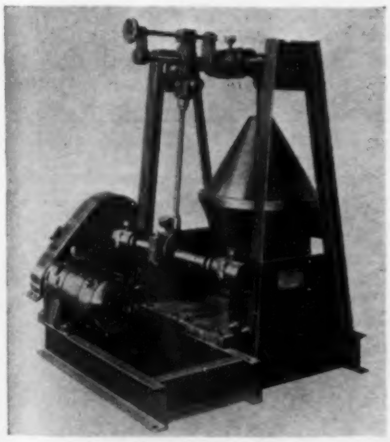
changer. Only one burner is required to obtain the 500,000 B.t.u. rating, thus simplifying adjustment and reducing maintenance. The burner equipment is of the low pressure proportioning type, said to be highly efficient in operation and to eliminate soot formation.

E. C. ATKINS & Co., Indianapolis, Ind., has developed a new electrically operated valve to which the name Atkomatic has been given. The valve is intended for operation on steam up to 150 lb. pressure, as well as all other liquids and gases. It contains only three moving parts. The line pressure is the main actuating force. Current energizing the solenoid coil lifts only a pilot valve, thus permitting the line pressure to accomplish the actual opening. Sizes range from ⅜ to 3 in.

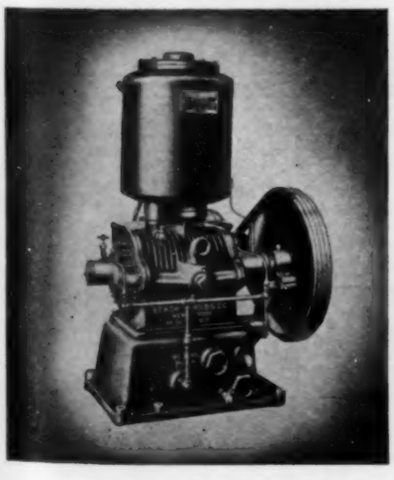
## Improved Diaphragm Pump

AS APPEARS from the accompanying illustration, several design improvements have been effected in the diaphragm pump made by the Hardinge Co., York, Pa. It is possible to vary the stroke, and hence the capacity, of the pump while it is in operation. New rugged construction has been employed and bearings so located that danger from splash has been eliminated. The lower valve has been made smaller in diameter than the upper one, so as to be capable of removal through the upper one for examination. For handling corrosive mixtures, the pump is provided with rubber covering on the pump body and valves or with other special construction materials, as required.

Improved Hardinge diaphragm pump



Air-cooled high vacuum pump



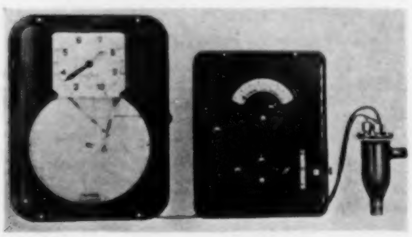
## New pH Instruments

DESIGNED especially for industrial plant use is a new line of pH recorders and controllers recently announced by the Bristol Co., Waterbury, Conn. These instruments employ the glass electrode method of measurement and are offered in two general types, a wide strip-chart model, and a round-chart model. Automatic controllers are offered in both electric- and air-operated models. Shielded glass and calomel electrodes are used for measurement and control. Electrode assemblies are of two types, the inclosed flow type in which the solution under measurement is pumped or allowed to flow through the chamber; and the immersion type, designed for suspension in tanks and vats. Automatic temperature compensation is provided.

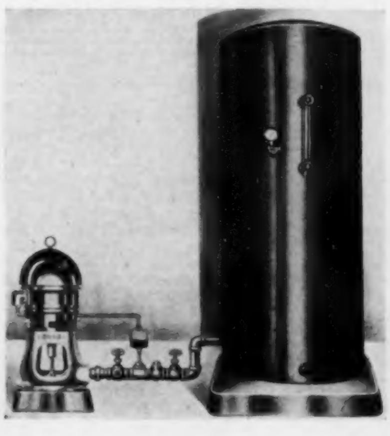
## High Vacuum Pumps

TYPE RP is the designation of an improved single-stage high-vacuum pump recently announced by the Beach-Russ Co., 50 Church St., New York, N. Y. Use of this company's characteristic rotary pump design is said to assure high exhaustion speed, higher vacuum and lower power consumption. Pressures maintained vary between 10 and 50 microns depending on operating conditions, although such pumps can be supplied for blank flange test down to 2 to 4 microns. The new pump is of the oil-sealed type with only four moving parts: an eccentric rotor, a gate and two packing strips. The standard Beach-Russ lubricating system and oil separator is mounted directly above the pump for dry work. For wet work, a modification of this device is used in which water and oil are separated for automatic discharge of the water while the pump is in operation. Smaller pumps are air-cooled while the larger members of the line are water-cooled. Being slow-speed machines, the pumps are said to be vibrationless and practically noiseless. Sizes range from 15 to 1,100 c.f.m.

New Bristol pH recorder



New medium-sized deep-well pump



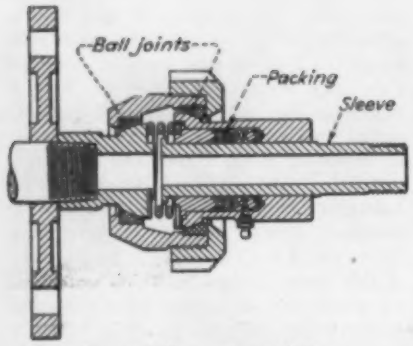
## Medium Sized Pump

LITTLE CHIEF is the name given to a new intermediate size deep-well pump for lifts from 10 to 200 ft. at pressures up to 40 lb. which is being built in sizes from 700 to 2,000 gal. per hour by the Pomona Pump Co., St. Louis, Mo., and Pomona, Calif. The new pump is water lubricated and makes use of rubber bearings. Motor sizes range from ¾ to 3 hp. with the vertical motor directly coupled to the drive shaft through a threaded coupling. All sizes have a 3-in. column with ¾ in. shaft, and bearings at 5-ft. intervals. Bowls are of 3½ in. outside diameter permitting entrance into a 4-in. well, and bowls are of this company's close-grained Pomoloy iron which is said to be highly resistant to corrosion. Impellers are of bronze, with copper-bearing steel used for the column pipe.

## Oscillating Granulator

A NEW and larger oscillating granulator of the automatic screen type has been developed by F. J. Stokes Machine Co., Olney P. O., Philadelphia, Pa., for use in granulating dried crystal masses, processing filter-press cake both before and after drying, breaking down material caked in storage, preparing wet mixtures for drying, breaking up compressed slugs for debulking operations and for

Large-capacity granulator




Cross-section of revolving flexible ball joint

Model F-O vibratory feeder

a variety of similar uses. The machine has a capacity up to 2,000 lb. per hour, is of heavy welded construction and is supplied with a built-in motor. A dust-tight discharge hopper can be furnished; and special construction materials provided, if desired.

## Revolving Ball Joint

FREE MOVEMENT in all directions can be provided through the use of a new flexible ball joint designed for connecting fixed piping to revolving drums or other revolving apparatus and put on the market by the Barco Mfg. Co., 1801 Winnemac Ave., Chicago, Ill. The only revolving part of this joint is the rotating sleeve which also provides a sliding movement in the event of end play in the revolving member. A siphon adapter is available which, added to the joint, makes possible flow of the fluid both to and from rotating member. The adapter is not shown in the drawing.

## Acid Resisting Bearings

BEARINGS and also rollers molded of non-metallic materials capable of resisting acids and organic solutions have been developed by the Gatke Corp., 228 North La Salle St., Chicago, Ill. The accompanying view shows one of these rollers supported on two bearings after operating 11 months in an electrolytic pickling tank where it was submerged in hot dilute sulphuric acid and lubricated only by this material. Such bearings are recommended by the manufacturer for use on agitators in mash tanks and steam cookers of distilleries and breweries, in the paper industry and for various services in chemical plants. A wide range of sizes and shapes is available.

Acid resisting roller and bearings

## Vibratory Feeder

CAPACITIES up to 2,000 lb. per hour of 100-lb. material can be fed with a high degree of accuracy, according to the manufacturers, with the new Model F-O vibratory feeder recently introduced by the Syntron Co., Homer City, Pa. The new machine, the smallest of this company's line, is intended for the feeding of reagents and similar materials in finely controlled feeds down to a few pounds per hour. A separate controller supplied with each feeder is used to regulate the vibratory action. This controller also contains the operating switch and a thermionic valve and is arranged for wall mounting.

## Reset Control Movement

TO COMPENSATE for the shift in control point which is brought about by the use of wide throttling range in controllers, American Schaeffer & Budenberg Instrument Div. of Manning, Maxwell & Moore, Bridgeport, Conn., has developed a new independent reset control. This device, the Micromoto Reset, may either be built into the case of the recorder-controller if it is purchased at the same time as the latter, or it may be added as a separate unit installed in the diaphragm motor valve air-line, either in connection with instruments made by this company or with those of other manufacturers. Many applications, according to the manufacturer, do not require the new reset, although its use is advocated in processes having widely varying load conditions, such as in fractionating towers, heat exchangers, barometric condensers and desuperheaters.

This new device is designed automatically to return the controlled temperature or pressure to the controller set point after a load change occurs. It begins to function immediately after a change in load, and is claimed to bring the controlled temperature back as rapidly as the process will permit. When applied to an existing control instrument, the new device is stated to be readily installed in the control air-line without touching the control instrument.

## Equipment Briefs

IPCO FOGGLE CLOTH is the name of a new treated cloth put out by Industrial Products Co., 800 West Somerset St., Philadelphia, Pa., which is used for cleaning, polishing and retarding the fogging of goggle lenses. The treating agent is a non-toxic wetting-out agent which reduces the surface tension of the glass. The cloth is said to be serviceable over a long period of time. It may readily be carried in the goggle case.

THE T.P.C. SAFETY SIPHON, which was described on page 207 of our April, 1938, issue, has now been taken over by the Pulmosan Safety Equipment Corp., 180 Johnson St., Brooklyn, N. Y. It will be recalled that this equipment, designed by a well-known chemical executive, is used for discharging the contents of carboys, drums and barrels, operating as a siphon once it has been primed by the operation of a flexible rubber bulb.

FOR THE PRODUCTION of small amounts of steam at temperatures as high as 350 deg. F., the Westinghouse Lamp Division, Westinghouse Electric & Mfg. Co., Bloomfield, N. J., has developed a flash-type electric heater in 1,000, 1,500 and 2,000 watt sizes, with evaporating capacities up to 5.7 lb. of water per hour. The transparent glass case of this miniature boiler is 9¼ in. long and capable of withstanding internal pressures to 25 lb. per sq. in. The boiler can produce superheated steam from cold water in less than 15 seconds.

# MANUFACTURERS' LATEST PUBLICATIONS

**Air Conditioning.** Carrier Corp., Syracuse, N. Y.—12-page condensed catalog of this company's air conditioning, refrigeration and heating equipment, with rating charts.

**Air Filters.** American Air Filter Co., First and Central Ave., Louisville, Ky. —Bulletin 250—8 pages describing principle, construction and operation of this company's new Electro-Matic combination electrical and mechanical air filter.

**Apparatus.** American Instrument Co., Silver Spring, Md.—Catalog CM15—164-page catalog on instruments and apparatus for testing cement, soils, and petroleum and its products.

**Bearings.** Stephens-Adamson Mfg. Co., Aurora, Ill.—Catalog 739—8 pages on this company's ball-bearing pillow blocks, flange units and take-up units, complete with dimensions.

**Centrifugals.** Sharples Corp., 2336 Westmoreland St., Philadelphia, Pa.—Publication 1221—20-page book approaching processing problems from the angle of centrifugal separation, with information on a variety of typical applications, list of users and brief descriptions of all types of centrifugals made by this company. Also Publication 1225, 20 pages describing construction details of this company's centrifugals and listing advantages of centrifugal processes.

**Chemicals.** Niacet Chemicals Corp., Niagara Falls, N. Y.—9th Edition, General Catalog—36 pages on specifications, containers, properties and users of this

company's synthetic organic chemicals, including glacial acetic acid, acetates and chemicals derived from acetic acid.

**Cleaning.** Quigley Co., 56 West 45th St., New York City—Form AN-128—6-page leaflet describing this company's Annite all-purpose cleanser, with information on types and uses.

**Construction Materials.** American Manganese Steel Div., American Brake Shoe & Foundry Co., Chicago Heights, Ill.—Catalog 59—64 pages on this company's production facilities for manganese steel, with information on properties of such steels and numerous applications.

**Construction Materials.** Burgess-Parr Co., Freeport, Ill.—Bulletin 103—6 pages on this company's alloy, Illium, giving general information, forms available at present, and including information on new rolled forms recently introduced.

**Construction Materials.** Colonial Alloys Co., Colonial-Philadelphia Bldg., Philadelphia, Pa.—Form 101738—Lists numerous applications of this company's alloy, Colalloy, in the chemical industry, illustrating typical uses.

**Construction Materials.** The International Nickel Co., 67 Wall St., New York City—17-page booklet entitled "Tremendous Trifles," describing how Monel, K-Monel, nickel and Z-nickel have been employed in the improvement of a variety of products.

**Electrical Equipment.** Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Publications as follows: B6012, 12 pages on this company's complete line of vertical-lift metal-clad switchgear; B6011, indoor cubicle type switchgear; B6010, list prices and other information on a-c and d-c motors.

**Electrical Equipment.** Cutler-Hammer, Inc., Milwaukee, Wis.—Publication CS-126—16-page booklet on the advantages of vertical contacts in motor controllers, particularly with reference to avoidance of troubles with dust.

**Electrical Equipment.** General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-137D, low-speed synchronous motors, Type TS; GEA-1960A, low-speed synchronous generators, Types ATB and ATI; GEA-2080, a-c and d-c solenoids for general industrial application; GEA-3071A, 8 pages, with engineering data, on industrial diesel-electric locomotives; GEA-3085A, 12 pages on single-phase, oil-immersed distribution transformers.

**Equipment.** Fuller Co., Catasauqua, Pa.—Bulletin CO-2—8 pages giving detailed description of this company's new air-quenching cooler for portland cement clinker.

**Equipment.** Gorton Heating Corp., Cranford, N. J.—Bulletin 108—4 pages describing this company's high-pressure air eliminators and automatic bypasses for steam heated equipment.

**Equipment.** Robins Conveying Belt Co., 15 Park Row, New York City—Bulletin 105—10 pages describing in detail this company's line of Vibrex vibrating screens; also Bulletin 106, 12 pages describing this company's Mead-Morrison car haulage systems and car retarders.

**Equipment.** Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin W-210-B24—6 pages describing this company's deaerating heaters and deaerators.

**Fire Protection.** The LaBour Co., Elkhart, Ind.—Bulletin 47—6 pages describing a fire trailer made by this company for fire protection in manufacturing establishments, designed for transportation by an ordinary passenger automobile. Includes self-priming pump, gasoline engine, and hose.

**Furnaces.** Ajax Electrothermic Corp., Trenton, N. J.—Publications as follows: Bulletin 12, 4 pages on small laboratory high-frequency furnaces; Bulletin 13, 8 pages on principles and construction of high-frequency furnaces for heating without melting; Form T-5, statements from engineering schools regarding this company's equipment; Form T-6, 18 pages on recent developments in the use of high-frequency furnaces.

**Furnaces.** Frazier - Simplex, Inc., Washington, Pa.—16-page catalog on this company's interlocking arch for industrial furnaces, describing construction details, refractories and various types of furnaces such as those for glass, metallurgical and boiler plants.

**Grinding.** Stephens-Adamson Mfg. Co., Aurora, Ill.—Catalog 639—12 pages on this company's air-swept attrition type Mosley mill for fine grinding and pulverizing of dry materials.

**Grinding.** The United States Stoneware Co., Akron, Ohio—Bulletin 250—4 pages describing various types of jar mills made by this company for laboratory and production work.

**Heat Exchangers.** Griscom-Russell Co., 285 Madison Ave., New York City—Bulletin 1615—8 pages on this company's extended surface heat exchange element known as the G-Fin Polysection, and its use in heat exchangers.

**Instruments.** The Esterline-Angus Co., Indianapolis, Ind.—Bulletin 339—12-page booklet on this company's sensitive milliammeter with description, specifications and information on a number of unusual applications.

**Instruments.** Industrial Instruments, Inc., 156 Culver Ave., Jersey City, N. J.—Leaflet RC-115—Conductivity bridges and dip cells; Leaflet MB-203, describes insulation resistance testers. Both leaflets include new models of instruments.

**Instruments.** Wheelco Instruments Co., 1929 South Halsted St., Chicago, Ill.—Bulletin 1001-1—Describes a new automatic electronic combustion safeguard which is similar to, but smaller than, this company's standard Model 1101 Flame-o-trol.

**Magnet Wire.** Anaconda Wire & Cable Co., Advertising Dept., 25 Broadway, New York City—Publication C-352, Second Edition—92-page revision of first edition of this company's magnet wire catalog; includes complete catalog and handbook information; also 40-page miniature handbook, briefing this information.

**Meters.** Roots-Connersville Blower Corp., Connersville, Ind.—Bulletin 40-B-15—4 pages on the use of this company's cycloidal devices as liquid meters and motors.

**Mixers.** J. H. Day Co., Cincinnati, Ohio—Bulletin 351—16 pages on this company's kneading and mixing machinery of the double-arm type, describing a variety of models and agitating arms.

**Pipe Threading.** The Oster Mfg. Co., 2057 East 61st Place, Cleveland, Ohio—Catalog 39-A—32 pages on this company's pipe and bolt threading equipment, including both hand- and power-operated models and several new types.

**Power Transmission.** Boston Gear Works, North Quincy, Mass. — Data Folder 8602—4 pages briefly describing a new line of Type SME straight-in-line motorized speed reducers recently announced by this company.

**Power Transmission.** The Carlyle-Johnson Machine Co., Manchester, Conn.—New 1939 clutch catalog, with description, specifications and information on latest improvements in this company's line of friction clutches.

**Power Transmission.** DeLaval Steam Turbine Co., Trenton, N. J.—Leaflet E-1175—16 pages on worm gear drives for industrial machinery, describing various types and illustrating numerous applications.

**Pumps.** Taber Pump Co., 288 Elm St., Buffalo, N. Y.—Bulletin SS-629, Sixth Edition—4 pages giving descriptions and ratings on various types of sump pumps made by this company.

**Refractories.** McLeod & Henry Co., Troy, N. Y.—12 pages on this company's silicon carbide, fire clay and high alumina furnace refractories, with information on properties and uses of the various types.

**Resin Equipment.** Republic Chemical Machinery Div., Hendrick Mfg. Co., 114 East 32d St., New York City—6-page pamphlet on the design of plant and equipment for making alkyd resins, particularly detailing information on satisfactory types of kettles and agitating mechanisms.

**Solvents.** Carbide & Carbon Chemicals Corp., 30 East 42d St., New York City—Chemical Group Folder No. 3—Pamphlet on Cellosolve solvents describing eight ether-glycols and two ether-glycol acetates, with information on properties and solvent powers.

**Testing.** The Twining Laboratories, Fresno, Calif.—15-page booklet describing this company's equipment and facilities for carrying out its claim of "testing anything".

**Tubing.** The Babcock & Wilcox Tube Co., Beaver Falls, Pa.—Technical Bulletin 15—New tables giving weight per foot for minimum-wall and average-wall tubes, hot-finished and cold-drawn, ranging in size from 1/16 in. o.d. to 10⅝ in. o.d.

**Valves.** Jenkins Bros., 80 White St., New York City—Form 183—24-page booklet on 125-lb. iron valves with detailed information on construction features of regrinding globe valves, regrinding swing-check valves, and outside-stem-and-yoke gate valves.

**Valves.** Merco Nordstrom Valve Co., 400 North Lexington Ave., Pittsburgh, Pa.—Bulletin V-129—12-page booklet describing this company's flexible-coupling valves of the lubricated plug type, showing numerous types, with dimension data.

**Water Treatment.** The Permutit Co., 330 West 42d St., New York City—Publications as follows: Bulletin 597, 32 pages on zeolite water softening, with information on manufacture and use of zeolites, detailing application methods; 2204, 16-page detailed description on this company's Spaulding precipitator for cold lime treatment of water; 2217, 2 pages on expansible strainer heads for filter and softener underdrain system; 2205, 4 pages on preparing water for ice making; 2218, 2 pages on automatic desludging valves; 2225, 15 pages describing in detail this company's pressure filters; also 9-page paper by D. J. Saunders on removal of iron and hardness from water and 12-page paper by Eskel Nordell on conditioning water for paper mills.

**Water Treatment.** Proportioneers, Inc., 9 Codding St., Providence, R. I.—Bulletin FOR—4 pages on the use of this company's chemical feeders in hypochlorination of water supplies; also reprint of a 3-page article by C. P. Hoover and Owen Rice on "Threshhold treatment" of water supplies with Calgon.

**Water Treatment.** L. A. Salomon & Bro., 216 Pearl St., New York, N. Y.—50-page book on taste and odor control of water using Norit activated carbon.

**Water Treatment.** William B. Scaife & Sons, Oakmont, Pa.—Bulletin 275A—12 pages describing this company's pressure water filters and their application.

**Welders.** Lincoln Electric Co., Cleveland, Ohio—Bulletin 314-A—4 pages describing a new 150-amp. electric welder with self-indicating dual continuous control.

**Wire Cloth.** Multi-Metal Wire Cloth Co., 1350 Garrison Ave., Bronx, N. Y.—47-page book on this company's wire and filter cloth, with engineering data, information on weaves and fabricated forms of such cloths, data on methods of fabrication, descriptions of various uses, with case histories, and extensive technical data section.

# Chemical Engineering NEWS

## Electrochemists Will Meet in New York Next Month

The Fall Meeting of The Electrochemical Society will be held in New York, Sept. 11–13, with headquarters at the Hotel Commodore. The opening session will be devoted to "Recent Progress in Electro Analysis" with Prof. Hiram Lukes of the University of Pennsylvania in charge. In the afternoon, members and guests of the Society will meet in the Hall of Science on the World's Fair grounds where Dr. Bradley Stoughton of Lehigh University will deliver the Sixth Joseph W. Richards Memorial Lecture. The subject of his address will be "Modern Marvels of Electrochemistry."

On the morning of Sept. 12, Dr. Robert B. Mears of the Aluminum Co. of America will conduct a symposium on the "Influence of Cathodic Reactions on Corrosion." There will be a round table discussion at luncheon and the symposium will be continued in the afternoon. In the evening the Acheson Medal Dinner will take place. Dr. Francis C. Frary, director of research of the Aluminum Co. of America, the recipient of the medal and prize, will speak on "Electrochemical Recollections."

Sessions on Sept. 13 will be devoted to papers on electrodeposition, batteries, etc.

## Wage Rates Established for Soap and Photographic Trades

The Secretary of Labor has determined that the prevailing minimum wages in the soap industry and in the photographic supplies industry are 40 cents an hour or $16 per week of 40 hours, arrived at either on a time or piece-work basis. Bids for contracts with the U. S. Government, subject to the Walsh-Healey act, which are solicited on or after Aug. 14, 1939, shall be considered only from companies which observe this minimum.

There is a provision in the photographic supplies industry determination that learners may be employed at lower rates for a period of not to exceed 60 days if the total number of such workers in any one establishment does not exceed 5 per cent of the workers on the payroll and if such learners are paid not less than 80 per cent of the minimum wage as determined. The minimum wage does not apply in the case of employees engaged in the manufacture of 35 millimeter cameras, projectors, and accessories therefor. Complete presentation of the case was published in the Federal Register on Aug. 1.

## Directory of Manufacturers Of Chemicals

The Facts and Figures issue of *Chem. & Met.* to be published in September, will contain a listing of actual manufacturers of chemicals in this country. In order to make this accurate and complete, questionnaires were sent to all manufacturers known to us. If your company did not receive the questionnaire or, if received, has not returned it, please advise us promptly so we may have your answer in time for publication.

## Student Course Included in Chemical Show Program

Included on the program for the Exposition of Chemical Industries which will open at Grand Central Palace, New York on Dec. 4, is a student course in chemical engineering. This course has become an established feature of the exposition and will again be under the supervision of Prof. W. T. Read dean of chemistry at Rutgers University. The course enables selected college students to coordinate lectures by leading authorities with actual examination of the materials and chemical engineering equipment discussed in the lectures.

Approximately 300 exhibitors have taken space to date and the management states that 200 of them have been exhibitors in previous years, many of them having been represented at the first exhibition held in 1915.

## Dr. Smith to Direct Study on Agricultural Motor Fuels

Dr. David F. Smith, professor of chemistry at the University of Buffalo, is to head the work on agricultural motor fuels at the Northern Regional Research Laboratory, Dr. Henry G. Knight, Chief of the Bureau of Agricultural Chemistry and Engineering announced last month. Doctor Smith's investigations, which will be carried on at Peoria laboratory, will be on research intended to develop methods of producing gaseous, liquid and solid motor fuels from agricultural materials. Dr. Smith did pioneer work in the study of possibilities of utilizing coal as fuel for internal combustion engines while connected with the U. S. Bureau of Mines.

## New Mineral and Metallic Compound Discovered

Discovery of a new mineral, officially named "shortite," was announced last month by the Department of the Interior. Composed of a double carbonate of sodium and calcium, the new mineral was found and identified by J. J. Fahey, chemist, in the Geological Survey laboratory. It was discovered as disseminated well-formed crystals in sections of core from the John Hay oil and gas well, in Sweetwater County, Wyoming, at depths of 1,250 to 1,800 feet below the earth's surface.

Although the commercial value of "shortite" is not yet definitely known, the new mineral is associated with considerable quantities of trona, sodium carbonate-bicarbonate, which does have potential commercial value. Trona was identified in a sample from this same well in 1938 by R. C. Wells, chief chemist of the Geological Survey.

Discovery of a metallic compound capable of cutting the toughest metals and harder than the hardest steel used in the manufacture of tools, is reported by the McKenna Metals Co., Latrobe, Penn. The material is obtained by heating tungsten, titanium, and carbon in pure graphite crucibles. The mixture is heated in a bath of molten nickel to a temperature of 2,000 deg. for a prolonged period. Upon cooling it is separated from the nickel by dissolving in aqua regia and other reagents and finally in hydrofluoric acid in platinum dishes.

## Bell Telephone Will build New Laboratories in New Jersey

The Bell Telephone Laboratories will construct a laboratory building on the property which it owns at Murray Hill, N. J. This new unit of the laboratories' buildings will house about 800 persons, or about seventeen per cent of the total personnel. The building and its permanent facilities are estimated to cost in the neighborhood of three million dollars; and its occupancy is expected during 1941. This new unit will provide space for certain groups in the research and apparatus development departments. The Murray Hill structure will contain laboratories for physical research, chemical research, outside plant development and material standards, together with the staff and service personnel necessary for their operation. There will also be housed in the building some other work of the research and apparatus development departments.

# NEWS FROM WASHINGTON

**Washington News Bureau**
**McGraw-Hill Publishing Co.**
**Paul Wooton, Chief**

IT IS practically impossible to raise any technical question either in Congress or with departmental people without running into the obvious, even when not spoken, question as to the 1940 significance of important decisions.

The adjournment of Senate and House closes a session, but not a Congress. There is much unfinished business which remains in status quo during the recess. Those bills approaching enactment will be advantageously situated for early consideration when Congress reconvenes. This will be in January unless some untoward international situation compels the President to call a special session. Unquestionably matters of international significance will be dominant in the planning and thinking whether the next meeting be a special or a regular session.

### New Anti-Freeze

Makers of alcohol have been worried by the gradual shrinkage of their antifreeze market. In dealing with government officials they have blamed their troubles on the popular objection to the strong odor of some of the denaturants used in the completely denatured formulas. For example, there has been much criticism of C.D. No. 14 on the ground that it is too malodorous for satisfactory automobile service.

Seeking to cooperate with the industry in this matter, the government has authorized a new type of anti-freeze formula based on a specially denatured alcohol. The new plan permits a manufacturer who wishes to make a proprietary antifreeze on the S.D.A.1 base to do this within certain limits. The product must be sold as a proprietary commodity in one gallon, or smaller, cans; drum distribution is forbidden. The formula desired must be submitted to the alcohol control authorities for approval at the time a permit is taken for withdrawal of the needed S.D.A. material.

At least one-half dozen manufacturers have been granted permits under this general authority. The formulas used include color and some form of substantial denaturant such as a petroleum distillate, and usually a rust inhibitor. Alcohol producers are hopeful that these, and other permitees, will do a lot of business next winter recapturing some of the antifreeze business which has been lost to methanol and to the non-evaporating competitors.

### Regional Labs Begun

Construction has been undertaken on all four of the new regional lab buildings, planned by the Department of Agriculture. Each of these main structures is to cost about $800,000, and enough more will be needed for general laboratory equipment to bring the fixed investment up to $1,000,000 at each site. Construction contracts indicate completion, ready for laboratory equipment, next spring; but active experimental work is not likely to begin at any one of the four sites until a year from September or October. The four laboratories are located at Philadelphia (suburban), New Orleans, Peoria, and Berkeley.

Some of the senior members of the research staff of each of the four laboratories are being named. Some of these men are being chosen from other government organizations, and a few former government men are being reinstated to take important posts. Additional new project chiefs will be chosen from the list of eligibles which has resulted from the civil service examination held in the early spring. A very large number made application under that examination, but a surprisingly small percentage were qualified. It may, therefore, be necessary to hold an additional examination for chemical engineers sometime during the coming fall or winter when the final staff is perfected.

One of the projects which the regional laboratory group has been forced to adopt deals with fundamental studies on methods for making motor fuels from agricultural raw material. This alky gas project will be directed by Dr. David F. Smith who retires from his teaching post at the University of Buffalo to head the Peoria laboratory. Other projects there will include studies on the fundamental problems of starch and starch derivatives, agricultural wastes, and the other related scientific and engineering work applicable particularly to the crops of the northern Great Plains states.

### New Transport Containers

Special permission has been given by Interstate Commerce Commission for the experimental use of fusion welded tank cars. A decision of July 11 authorized the building of 10 such units for transport of special petroleum products, and another decision of July 15 authorized 50 tank cars for caustic soda solution. In making these announcements the Commission executives called attention to previous satisfactory experience with 241 such welded cars which have been used for a number of years in 7,000 trips totaling more than 6,000,000 miles of safe transportation. Permission to use welded tanks is, however, still a matter of special action as only riveted tanks are yet recognized for unlimited construction and service.

### News "Fines"

Drug Wages—Those who sell drugs or medicines to Uncle Sam must meet new minimum wage requirements of the Department of Labor, under the Walsh-Healey law. A finding of July 19 requires a minimum wage in the drug and medicine finishing establishments of 37.5 cents per hour, or $15 per week of 40 hours. This finding indicates the approximate basis on which comparable employment is likely to be limited elsewhere in similar industries.

Countervailing Duty—Further evidence of the government's intention to police imports which are subsidized by the countries of origin is shown in a recent Treasury finding. This requires the imposition of an extra duty on silk goods from Italy because the Treasury finds that the Italian government is giving financial assistance to exporters of those goods from Italy. Importers of other commodities, believed to be similarly subsidized abroad, now have several precedents on which to appeal to the Treasury for comparable action.

Pollution Control Delayed—Members of the House have agreed that they will not undertake to enact this year the bill to abate stream pollution. That measure has passed the Senate and is understood tc meet the President's wishes, but is now scheduled to remain in the House Committee on Rivers and Harbors until next year. If and when enacted, it will provide for fundamental investigations by the Public Health Service and a broad regulatory plan which will become compulsory after a period of years.

Rubber Barter—The plan to get rubber in exchange for cotton was almost upset by demands of cotton warehouse men. They did not want Uncle Sam to get rid of some of his surplus lest they lose their nice income from storage charges. They also argued that the grading of the cotton, for which they get a substantial fee, should be done in the interior warehouses and not at the seaboard as agreed upon by the British-American treaty. These selfish moods for a time threatened to prevent the preparedness program which would give the United States a large military reserve of rubber in exchange for the cotton which Britain would hold similarly for its own emergency uses. Late in July it is understood in Washington that cash sales of U. S. government-owned cotton are also being arranged with France and Switzerland, and perhaps another unnamed country, for similar emergency reserves.

## GOVERNMENT DECREE AFFECTS SELECTION OF FIBERS FOR GERMAN TEXTILE PLANTS

**From Our German Correspondent**

FAR-REACHING changes in the textile industry since July 1 have been occasioned by a government decree forbidding admixture of cotton or linen with staple fiber in manufacturing fabrics for certain uses, and requiring that they be made exclusively of cell wool. Officials claim this is possible since a 200,000 ton-a-year cell wool production capacity—to be extended to 350,000 next year—has been attained, and that the fibers have been qualitatively improved to stand up alone. The fact that working clothes, uniforms, bedding, and underclothing have been excluded would indicate, however, that the pure staple fiber fabrics still do not have the hard-wearing qualities of the natural.

The new decree divides fabrics into three large groups: fabrics of (1) pure cell wool, (2) cell wool mixed with natural fibers, (3) pure natural fibers such as cotton and flax. For woolens the admixture of staple fiber will be continued in roughly the same ratios as heretofore. Goods manufactured exclusively for export are not affected by the decree. In the future, however, for domestic consumption, textiles for flags, linings for clothing, suitcases, hats, colored table cloths, printed goods, etc., must be made of pure cell wool.

The largest part of the 155,000 metric tons of German cell wool output last year was produced by viscose processes, as against only 8,500 and 3,000 tons of cell wool by the acetate and cupric processes, respectively. 45,000 tons of the total represented cell wool type "W," which went to the carding industry, while by far the largest part was processed in cotton spinning plants.

In line with the new fiber decrees prohibiting the admixture of natural fibers and increasing the use of synthetic fibers, Glanzstoff-Courtaulds G.m.b.H., Cologne, announces it is starting large-scale production of a special cell wool. This fiber, developed over a number of years, is claimed to be strong and uniform, although very fine, and especially adaptable for making fabrics without addition of natural fiber. Kurmaerkische Zellwolle und Zellulose A.G., Wittenberge, is planning to double its capacity by late autumn to provide for a yearly output of 36,000 tons cellulose, 18,000 tons cell wool, and for the first time, 11,000 tons of jute cell wool.

Experiments carried out at a pilot plant in Hirschberg in Silesia with beech and pine wood, and rye and wheat straw to determine their suitability for textile fiber production have been successful, according to reports. Sulphite, monosulphite, sulphate, and sodium processes tested indicated that the sulphate process is most adaptable since it reduces the resin content of pine and the high ash content of straw. In Hirschberg a large plant is being erected to produce cell wool directly from pine according to the sulphate process, and in Wittenberge the same process is to be used for processing straw.

A break-down of last-year's 6,000 million RM record production of the German chemical industry, according to ultimate uses, just published in the "Chemische Industrie" shows the following distribution: Domestic Sales: Chemical products in the foodstuffs field: fertilizers, insecticides, veterinary supplies, fodder, preserving materials, baking powder, chemical nutrients, refrigeration chemicals, etc., 700 mil. RM.

Chemical products for household, public health, and cultural needs: medicinals, soaps, cleansing agents, matches, photochemicals, ink, pencils, etc., 1120 mil. RM.

Chemical products for clothing industry: coal tar dyes, textile chemicals, moth repellents, rayon, tanning materials, leather chemicals and protectives, etc., 740 mil. RM.

Chemical products for building and construction: building material chemicals, insulating, binding, impregnating materials, roofing paper, paint, lacquer, glue, floor coverings, etc., 550 mil. RM.

Chemical products for transportation industry: synthetic motor fuels, lubricants, tires, safety glass, spraying lacquers, etc., 800 mil. RM.

Miscellaneous technical raw and factory materials: light metals, alloys, electrotechnical insulating materials, plastics, synthetic resins, soda for glass industry, oxygen and acetylene for welding, solders, abrasives, solvents, active carbons, other heavy chemicals, explosives, etc., 1200 mil. RM.

Exports: Exports, foreign patent and license holdings, income from subsidiaries and participation, appr. 750 mil. RM.

By the end of this year, according to industrial raw materials commissar Major General von Hanneken, passenger automobiles will be equipped exclusively with Buna tires. This means that roughly a quarter of the yearly caoutchouc requirements of 100,000 metric tons will be supplied by synthetic rubber. The latest Buna plant at Schkopau has just been completed and is ready to undertake large scale production.

A new large photochemical plant is projected by I.G. Farbenindustrie A.G. at Landsberg a.d. Warthe. Although the entire plant, which is to produce part of the "Agfa" photographic articles, chiefly for export, will not be completed for two years, it is hoped to have some units in operation next year.

Further expansion of I.G. is indicated in the latest annual report. Financial participation in other firms increased from 229 million RM in 1937 to 310 million RM in 1938, and assets in plants increased from 515 to 605 million RM. New participations are chiefly in Austrian and Sudetic German firms. The number of employees of the concern, including subsidiaries and affiliates, rose from 193,000 to 218,000 in 1938.

Among new materials used in German laboratories and industries is a new pH testing paper which combines the simple principle of litmus paper with the exactness of a folio colorimeter. Strips of a special type filter paper 12 mm. by 85 mm. are saturated with the indicator as well as with a number of colors for comparison. A broad strip in the middle represents the indicator and a number of narrower strips of color on either side with printed numerical pH values make immediate computation possible. After dipping the whole paper into the solution to be measured, the shade of the middle indicator strip is compared with the corresponding color strip on the side. Colors or dyes in the solutions themselves do not invalidate the results since the comparison colors are changed along with the center color indicator.

A plastic plyboard table top for laboratories, consisting of a 2 to 3 mm. thick center plastic sheet upon which asbestos plates have been pressed, above and below, is also on the market after having been tried out successfully for four years in a large German chemical laboratory. It is claimed that the three-ply tops combine the advantages of both materials, i.e., heat and chemical resistance of the asbestos, and elasticity of the plastic leaf, and are especially resistant to acids and lyes, do not swell when wet, nor crack or chip when heavy objects are thrown down upon them. The plates, which are available in various sizes and can be sawed and machined, are fastened onto the tables with brass or zinc angle irons or screws. Lathes, electric motors, etc., can be operated on the table tops, upon which one can also easily write and erase pencil markings and they can be resurfaced by rubbing with emery cloth.

A patent placed recently at the disposal of industries by the bureau of "stone and earth industries" is a new heat protector before glass furnaces. Satisfactorily used in one glass plant for some time, the arrangement consists of a fine-meshed wire screen with water dripping over it. Placed before the opening of the glass furnace, it is stated to reduce the temperature on the operator's side by 80 per cent without interfering with his freedom of movement in front of the furnace.

# PERSONALITIES

Greystone

Emil Ott

✦ Emil Ott has been appointed director of research for the Hercules Powder Co. He will be located at the Experimental Station near Wilmington, Del. O. A. Pickett continues as director of the Station. Dr. Ott was born in Zurich, Switzerland, and graduated from the Swiss Institute of Technology. After receiving his Ph.D. degree, in 1927, he came to America and after several years of practical chemical experience, became assistant professor of chemistry at Johns Hopkins University. He was engaged as consultant for Hercules in 1933 and a few months later became a member of the company's development department. In 1937, he was appointed head of the research department.

✦ George W. Jernstedt, chemical engineer of the meter division, Westinghouse Electric & Manufacturing Co., Newark, N. J., has been awarded the Benjamin Garver Lamme graduate scholarship for the year 1939-40. The scholarship is awarded annually by the Westinghouse company to one of its young engineers.

✦ J. H. Boyd, Jr., has resigned his position with the Du Pont Ammonia Department to go with Phillips Petroleum Co., Bartlesville, Okla.

✦ Louis DeBlois, consulting engineer, has been elected executive vice-president of the Greater New York Safety Council.

✦ Joe C. Danec, chemical engineer, has recently been added to the technical staff of Battelle Memorial Institute, Columbus, Ohio. He is a graduate of Lafayette College.

✦ Raymond B. Seymour has resigned his position with the Goodyear Tire & Rubber Co. to join the research staff of the Atlas Mineral Products Co., Mertztown, Pa.

✦ C. R. Payne, who for several years has been in charge of research for the Atlas Mineral Products Co., has been elected a director and vice-president. Dr. Payne was associated with Mellon Institute for several years prior to 1935.

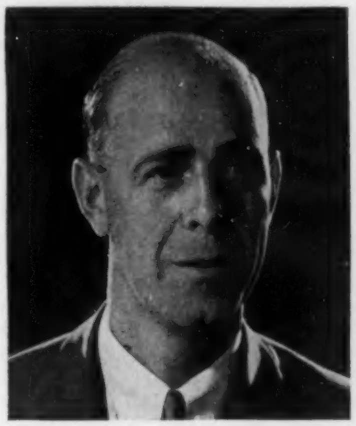
✦ J. T. Tierney has been elected chairman of the executive committee of the board of trustees of Koppers United Co. He succeeds C. D. Marshall, who recently resigned. Mr. Tierney continues as president.

✦ J. P. Williams, Jr., succeeds Mr. Tierney as president of Koppers Co.

✦ Charles Carpenter, technical director of the Herty Foundation Laboratory at Savannah, Ga., has resigned to become associated with the Southland Paper Mills as chemist.

✦ Carroll H. Henkel, chemical engineer, has joined the research staff of the Battelle Memorial Institute. He will be engaged largely in the problems relating to tin and its uses.

✦ Robert B. Semple has been transferred from manager of the pilot plant department to assistant director of development of the Monsanto Chemical Co., St. Louis, Mo.



Leslie S. Gillette

✦ Leslie S. Gillette has resigned his position with the U. S. Industrial Alcohol Co. He was originator and chief editor of *Solvent News*. On August 1, Mr. Gillette became executive vice president of the Hazard Advertising Corp.

✦ Fred Denig, vice-president of the Koppers company's engineering and construction division, has been appointed to the newly created post of director of research for all companies and divisions of the Koppers group.

✦ George Reid has resigned his position as editor of *The Refiner* to become executive secretary of the Gulf Coast Refiners Association, Houston, Tex.

✦ Harold Judd Payne has resigned as executive vice president of the Associated Business Papers to become vice president and a director of F. W. Dodge Corp. He is a chemical engineering graduate of M.I.T. and formerly a member of the staff of *Chem. & Met.*

✦ Leo Stander, president of the Hauser Stander Tank Co. of Cincinnati, died July 30 of a heart ailment. He was 61 years of age. For 40 years Mr. Stander had been president of the company.

## CALENDAR

SEPT. 11-13, Electrochemical Society, fall meeting, Hotel Commodore, New York, N. Y.

SEPT. 11-15, American Chemical Society, fall meeting, Boston, Mass.

SEPT. 12-14, Technical Association of the Pulp & Paper Industry, fall meeting, Hotel Syracuse, Syracuse, N. Y.

NOV. 13-17, American Petroleum Institute, annual meeting, Stevens Hotel, Chicago.

NOV. 15-17, American Institute of Chemical Engineers, annual meeting, Providence-Biltmore Hotel, Providence, R. I.

DEC. 4-9, Chemical Exposition, Grand Central Palace, New York City.

# Chemical ECONOMICS and MARKETS

## FAVORABLE OUTLOOK FOR MOVEMENT OF CHEMICALS FOR THIRD QUARTER OF YEAR

SEASONAL influences were reported as responsible for moderate declines in the movement of such commodities as pigments, dry colors, fertilizer materials but many other chemical products found a ready market in the last month and optimistic views are fairly general both regarding the current tonnage movement and the outlook for the next two or three months. Preliminary figures indicate that the Chem. & Met. index for consumption of chemicals fell close to 116 in July. The index for July 1938 was

***Chem. & Met.*** **Index for Consumption of Chemicals**

| | May Revised | June |
|---|---|---|
| Pulp and paper | 15.64 | 15.50 |
| Fertilizer | 22.55 | 19.60 |
| Glass | 12.10 | 13.08 |
| Petroleum refining | 13.80 | 13.62 |
| Paint and varnish | 13.59 | 12.40 |
| Iron and steel | 6.06 | 6.60 |
| Rayon | 7.92 | 8.06 |
| Textiles | 7.46 | 8.48 |
| Coal products | 4.93 | 6.31 |
| Leather, glue, and gelatin | 3.76 | 3.88 |
| Explosives | 4.28 | 4.40 |
| Rubber | 2.52 | 2.70 |
| Plastics | 1.88 | 1.84 |
| | 116.49 | 116.41 |

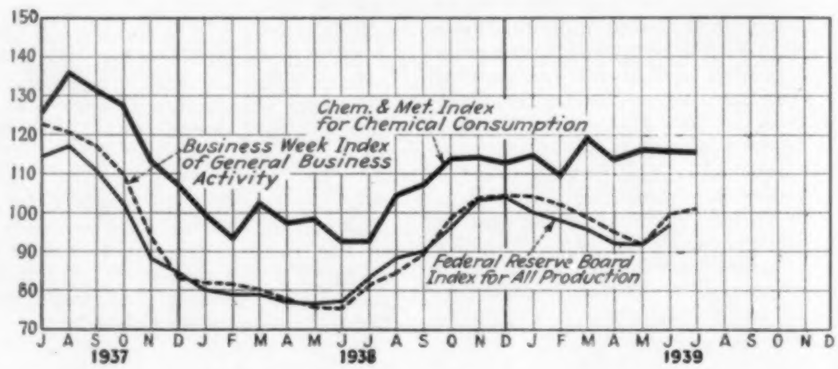
92.66 and revised indexes for June and May this year are 116.41 and 116.49 respectively.

The index for July is more than 25 per cent above that for the corresponding month of last year. However, business improved last August and September and the consumption index for the third quarter averaged 101.48 which means that the present quarter must average 119.75 if the 18 per cent rate of gain over last year, as established in the January–June period, is to be maintained.

In a resume of the glass industry for the first half of this year, the Department of Commerce states that plate glass production was twice as large as in the first six months of 1938; window glass production gained 72 per cent; glass container output, 17 per cent; illuminating glassware sales, 25 per cent; and tableware lines, 12 per cent.

The Department of Commerce reports that sales of manufacturers in June were 17.5 per cent above those for June, 1938 and were up 2.2 per cent from May, 1939. Comparing sales for June with those for June, 1938 and with May, 1939, the following changes were reported: chemicals and allied products, up 24 and down 5.8; paint and varnish, up 20.1 and down 8.2; other chemicals, up 27.6 and down 4.1; textiles, up 25.8 and up 2.7; paper and allied products, up 15.1 and up 2.7; rubber and products, up 17.7 and up 22.9; stone, clay, and glass, up 17.8 and up 5.3. These figures refer to percentage changes.

The outlook for business in general for the near future is favorable based on current reports. The Federal Reserve Board index for industrial production jumped from 92 in May to 97 in June. The index for general business published by *Business Week* reached 92.8, its low point of the year, in May, went to 99.6 in June and to 100.7 in July. The Regional Shippers Advisory Boards forecast a gain of only 3.5 per cent in carloadings of chemicals and explosives for the third quarter of the year compared with the corresponding period of last year. However, large gains were forecast for some of the industries which are heavy consumers of chemicals and the figure for chemicals appears to be too low.

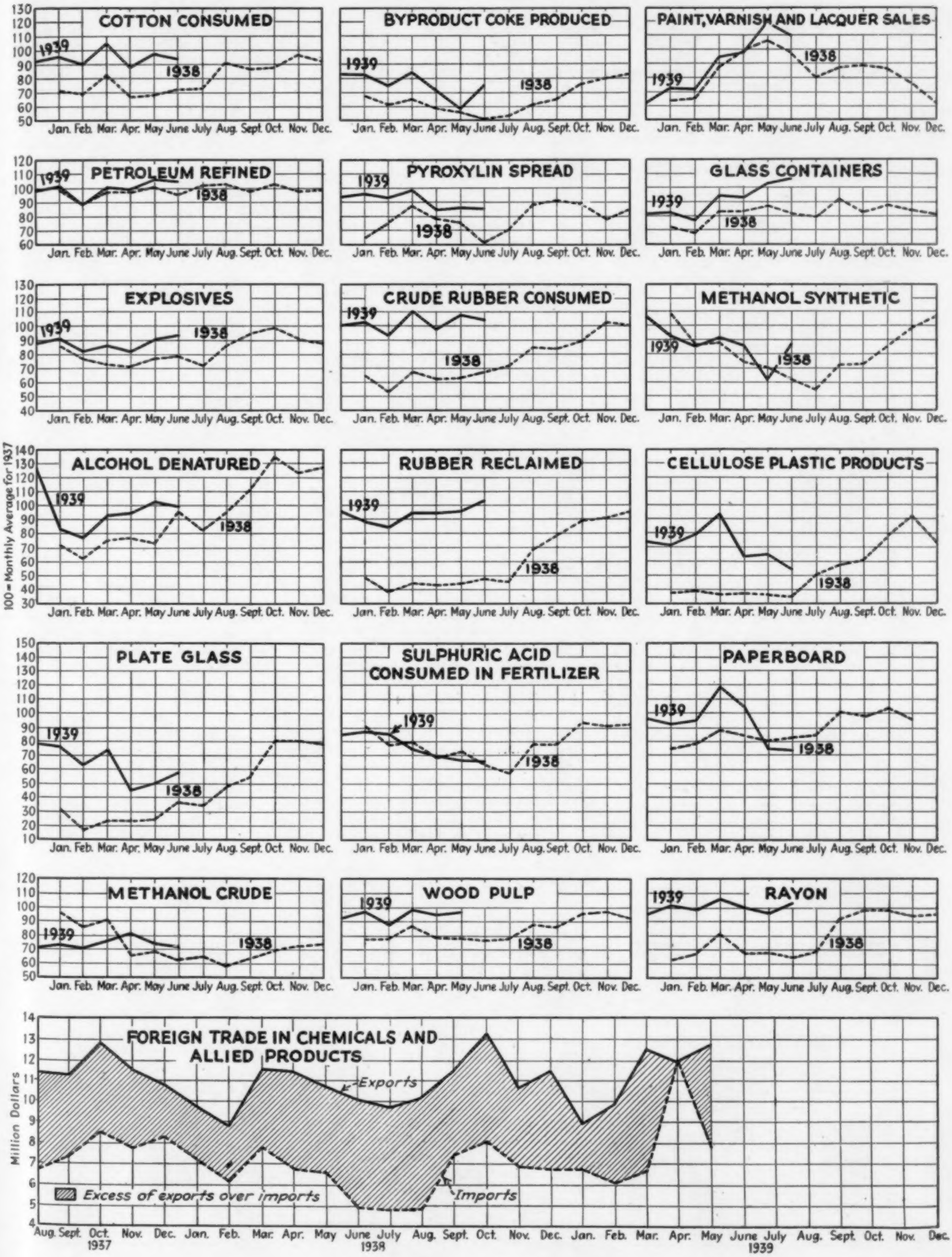



**Production and Consumption Data for Chemical-Consuming Industries**

| **Production** | June 1939 | June 1938 | January–June 1939 | January–June 1938 | Per Cent of gain for 1939 |
|---|---|---|---|---|---|
| Alcohol, ethyl, 1,000 pr. gal | 16,827 | 16,395 | 102,502 | 94,166 | 8.9 |
| Alcohol denatured, 1,000 wi. gal | 8,166 | 7,869 | 45,273 | 37,426 | 20.7 |
| Ammonia, liquor, 1,000 lb | 4,228 | 3,179 | 24,285 | 20,752 | 17.0 |
| Ammonium sulphate, 1,000 lb | 84,506 | 55,934 | 498,316 | 404,221 | 23.3 |
| Benzol, 1,000 gal | 7,292 | 4,413 | 42,553 | 32,431 | 31.2 |
| Byproduct coke, 1,000 tons | 3,090 | 2,067 | 18,284 | 14,717 | 24.2 |
| Glass containers, 1,000 gr | 4,662 | 3,583 | 24,356 | 20,824 | 15.5 |
| Plate glass, 1,000 sq. ft | 9,289 | 5,956 | 58,834 | 25,227 | 133.2 |
| Methanol, synthetic, gal | 2,295,288 | 1,629,570 | 13,487,041 | 12,997,300 | 3.8 |
| Methanol, crude, gal | 343,992 | 293,091 | 2,140,301 | 2,238,707 | 4.0 |
| Nitrocellulose plastics, 1,000 lb | 957 | 612 | 6,397 | 4,046 | 58.1 |
| Cellulose acetate plastics, 1,000 lb. | | | | | |
| Sheets, rods and tubes | 446 | 288 | 4,407 | 1,645 | 160.8 |
| Molding compounds | 795 | 465 | 4,872 | 2,760 | 75.9 |
| Pyroxylin spread, 1,000 lb | 4,710 | 3,341 | 29,831 | 24,279 | 22.9 |
| Rubber reclaimed, tons | 15,871 | 8,196 | 86,551 | 42,567 | 103.3 |
| Sulphuric acid, in fertilizer, tons | 140,580 | 114,199 | 963,278 | 893,264 | 7.8 |
| **Consumption** | | | | | |
| Cotton, bales | 578,448 | 443,043 | 3,534,024 | 2,655,103 | 33.1 |
| Silk, bales | 26,256 | 31,492 | 192,106 | 189,419 | 1.4 |
| Wool, 1,000 lb | 30,063 | 18,780 | 181,801 | 97,915 | 85.7 |
| Explosives, sales, 1,000 lb | 30,210 | 25,445 | 169,516 | 149,096 | 13.7 |
| Rubber, crude, tons | 47,259 | 32,540 | 274,566 | 175,061 | 56.8 |
| Sulphuric acid, in fertilizer, tons | 106,137 | 102,228 | 727,424 | 733,912 | 0.9* |

* Per cent of decline.

# Production and Consumption Trends



## PRICES FOR OILS AND FATS WERE REDUCED SHARPLY LAST MONTH

THE uneven rate of progress reported for industry in general last month, found a counterpart in the demand for chemical products. In some instances, consuming industries had expanded their operating schedules with a corresponding increase in taking on stocks of chemicals and other raw materials. In other directions, the effects of the traditional hot-weather period were apparent in a curtailment of operations with a consequent fall in consumption of chemicals. The lower-priced chemicals—notably sulphuric acid in its largest field of superphosphate production—appear to have led in the slower movement and it is probable that the total tonnage movement of chemicals was not accompanied by a similar drop in the dollar volume.

Price movements were mixed with advances reported for casein, lead oxides, tin salts, and sulphate of ammonia. Effective Aug. 1, producers of monobutylamine quoted a flat price for that product of 48¢ per lb. in tanks, 50¢ per lb. in drums, carlots, and up to 53¢ per lb. for less than carlots. This revision was practically a price advance since it abolished the discount formerly allowed. Producers of mannitol announced a lower sales schedule for that product with quotations for reagent grade at 95¢ per lb. for 100 lb. lots and for commercial grade 42¢ per lb. in ton lots. Naval stores failed to maintain prices and both turpentine and rosins were available at figures below those quoted a month ago.

Turning to oils and fats it is found that the course of prices has reached an alarmingly low point. The large stocks hanging over the market have had a demoralizing effect and government aid has been sought in an effort to stabilize the market. Proposals that barter arrangements be made with foreign countries so that part of the surplus may be moved out of the country, are said to have met with consideration which may result in something definite along those lines. A meeting of peanut growers also is scheduled with government officials at which it is expected that the question of crop diversion will be discussed with a view to cutting down the crush of peanuts next season. Paint-making oils have not followed the general tenor although linseed oil was easier at the close of the period. China wood oil still feels the uncertainty regarding shipments from China and current quotations at 21¢ per lb. in tanks are too high to encourage much trading even if the supply would admit it. Perilla oil has been marked up steadily in price and here again the visible supply is said to be restricted. Oiticica oil has come into popular use as a drying oil partly because of the scarcity of competing oils and partly because its merits have become better known. The Department of Commerce reports that no production statistics are available, but fourteen plants are known to be engaged in crushing the nuts in Brazil at present. Imports into the United States during the first five months of the current year aggregated 5,328,500 lb. valued at more than $400,000, which is more than was imported during the whole of 1938. Great impetus has been given to the oiticica oil industry by conditions in China, which have restricted the exportation of tung oil from that country and caused its price to rise sharply in world markets. With the rise in the price of tung oil, more oiticica is being used by paint and varnish manufacturers, as formulas suitable for its use are being developed by paint and varnish chemists.

While oiticica nuts are available in large quantities in Brazil, many of the trees are found in inaccessible places remote from regular routes of transportation and must be transported by pack animals at considerable expense. At prevailing prices for the oil, however, it is believed that these areas can be profitably worked and that production may be expected to increase as long as the present price level holds.

Paint, varnish, lacquer and fillers sold in June were valued at $38,504,857, compared with $41,853,977 in May, and $33,936,706 in June, 1938. The value of plastic paints sold during June amounted to $42,684, against $45,332 in May and $42,947 in June, 1938. The value of cold-water paints sold in June was $536,383, against $567,739 in May, and $368,529 in June of last year. The value of calcimines totaled $281,258 in June, $305,023 in May, and $242,544 in June, 1938. Sales of clear lacquers, pigmented lacquer bases and dopes, and thinners for the first quarter of 1939 totaled 10,613,936 gal., valued at $13,283,875, compared with 7,981,566 gal., valued at $10,209,757, for the corresponding period of 1938.

Tharsis Sulphur and Copper Co., Ltd., Glasgow, operators of pyrites mines in Spain reported that statistics show pyrites deliveries by 48 European mining companies in 1938 at slightly under 6,500,000 long tons. One-fourth of the producers operated in Spain and they accounted for 36½ per cent of the total volume. Deliveries were made to 24 countries.

The Gafsa Co. of Tunisia, leading producer of phosphate rock, recently reported that North African producers of phosphate rock are cognizant of the growing demand by fertilizer manufacturers for high-grade rock. A research organization was founded by Tunisian producers under the auspices of the Government to investigate the possibility of upgrading the rock by flotation or other methods, the objective being, if possible, to market material containing 80–85 per cent tricalcium phosphate.

The Yugoslav Administration of State Monopolies is reported to have under consideration the establishment of a modern plant, with a capacity of 1,000 tons a year, for the production of nicotine from Yugoslav tobacco. The equipment for this factory will be imported from Germany.

A new sulphuric acid plant with daily output of 50 to 55 metric tons, started operations at Affecking, near Kelheim, Upper Bavaria, in the latter part of 1938. It is owned by the Bayerische A. G. fur Chemische und Landwirtschaftliche Fabrikate, Huefeld, Upper Bavaria. It is the first German acid plant to be based upon Bavarian iron pyrites for its raw material. Heretofore nearly all of Germany's output of iron pyrites has been furnished by mines situated at Meggen, Westphalia. Output of acid by the new plant at Affeking will be taken entirely by a new plant at Kelheim for producing cut-staple rayon.

Construction of another new and much larger sulphuric acid plant was started in February 1939 at Moosbierbaum, Austria, by the leading Austrian chemical concern, Skoda-Wetzler A. G. This plant will represent a capital investment of around 3,000,000 marks.

### CHEM. & MET.
**Weighted Index of**
### CHEMICAL PRICES

Base=100 for 1937

| | |
|---|---|
| **This month** | **96.96** |
| Last month | 97.02 |
| August, 1938 | 99.54 |
| August, 1937 | 100.35 |

Although there were evidences of a reversal in the price trend with some actual advances, the index number again fell slightly owing to the greater weight of the downward revisions with naval stores contributing to the decline.

### CHEM. & MET.
**Weighted Index of Prices for**
### OILS AND FATS

Base=100 for 1937

| | |
|---|---|
| **This month** | **66.80** |
| Last month | 70.33 |
| August, 1938 | 79.37 |
| August, 1937 | 92.47 |

With the exception of linseed oil, paint-making oils were more firmly held. Other oils, however, were generally lower and combined with weakness in prices for animal fats, the effect was to cause a sharp break in the index number.

# Current PRICES

## INDUSTRIAL CHEMICALS

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Acetone, drums, lb | $0.05½–$0.06½ | $0.05½–$0.06½ | $0.05½–$0.06½ |
| Acid, acetic, 28%, bbl., cwt | 2.23 – 2.48 | 2.23 – 2.48 | 2.23 – 2.48 |
| Glacial 99%, drums | 8.43 – 8.68 | 8.43 – 8.68 | 8.43 – 8.68 |
| U. S. P. reagent | 10.25 –10.50 | 10.25 –10.50 | 10.25 –10.50 |
| Boric, bbl., ton | 106.00–111.00 | 106.00–111.00 | 105.00–115.00 |
| Citric, kegs, lb | .20 – .23 | .20 – .23 | .23½– .26 |
| Formic, bbl., ton | .10½– .11 | .10½– .11 | .10½– .11 |
| Gallic, tech., bbl., lb | .70 – .75 | .70 – .75 | .70 – .75 |
| Hydrofluoric 30% carb., lb | .07 – .07½ | .07 – .07½ | .07 – .07½ |
| Lactic, 44%, tech., light, bbl., lb | .06½– .06¾ | .06½– .06¾ | .06½– .06¾ |
| Muriatic, 18°, tanks, cwt | 1.05 –...... | 1.05 –...... | 1.05 –...... |
| Nitric, 36°, carboys, lb | .05 – .05½ | .05 – .05½ | .05 – .05½ |
| Oleum, tanks, w'ks., ton | 18.50 –20.00 | 18.50 –...... | 18.50 –20.00 |
| Oxalic, crystals, bbl., lb | .10¾– .12 | .10¾– .12 | .10¾– .12 |
| Phosphoric, tech., c'bys., lb | .07½– .08½ | .07½– .08½ | .09 – .10 |
| Sulphuric, 60° tanks, ton | 13.00 –...... | 13.00 –...... | 13.00 –...... |
| Sulphuric, 66°, tanks, ton | 16.50 –...... | 16.50 –...... | 16.50 –...... |
| Tannic, tech., bbl., lb | .40 – .45 | .40 – .45 | .40 – .45 |
| Tartaric, powd., bbl., lb | .27½–...... | .27½–...... | .27½–...... |
| Tungstic, bbl., lb | 2.35 –...... | 2.35 –...... | 2.75 –...... |
| Alcohol, Amyl | ....–...... | ....–...... | ....–...... |
| From Pentane, tanks, lb | .101–...... | .101–...... | .106–...... |
| Alcohol, Butyl, tanks, lb | .07 –...... | .07 –...... | .08½–...... |
| Alcohol, Ethyl, 190 p'f., bbl., gal | 4.54 –...... | 4.54 –...... | 4.58½–...... |
| Denatured, 190 proof | | | |
| No. 1 special, bbl., gal. wks | .26½–...... | .26½–...... | .29 –...... |
| Alum, ammonia, lump, bbl., lb | .03½– .04 | .03½– .04 | .03½– .04 |
| Potash, lump, bbl., lb | .03¾– .04 | .03¾– .04 | .03¾– .04 |
| Aluminum sulphate, com. bags, cwt | 1.15 – 1.40 | 1.15 – 1.40 | 1.15 – 1.40 |
| Iron free, bg., cwt | 1.30 – 1.55 | 1.30 – 1.55 | 1.30 – 1.55 |
| Aqua ammonia, 26°, drums, lb | .02 – .03 | .02 – .03 | .02½– .03 |
| tanks, lb | .02 – .02¾ | .02 – .02¾ | .02½– .02¾ |
| Ammonia, anhydrous, cyl., lb | .15½–...... | .15½–...... | .15½–.16 |
| tanks, lb | .04½–...... | .04½–...... | .04½–.16 |
| Ammonium carbonate, powd. tech., casks, lb | .08 – .12 | .08 – .12 | .08 – .12 |
| Sulphate, wks, cwt | 1.40 –...... | 1.35 –...... | 1.325–...... |
| Amylacetate tech., tanks, lb | .09½–...... | .09½–...... | .11 –...... |
| Antimony Oxide, bbl., lb | .10 – .11 | .10 – .11 | .11½– .12 |
| Arsenic, white, powd., bbl., lb | .03 – .03½ | .03 – .03½ | .03 – .03½ |
| Red, powd., kegs, lb | .15½– .16 | .15½– .16 | .15½– .16 |
| Barium carbonate, bbl., ton | 52.50 –57.50 | 52.50 –57.50 | 52.50 –57.50 |
| Chloride, bbl., ton | 79.00 –81.00 | 79.00 –81.00 | 79.00 –81.00 |
| Nitrate, casks, lb | .07 – .08 | .07 – .08 | .07 – .08 |
| Blanc fixe, dry, bbl., lb | .03½– .04 | .03½– .04 | .03½– .04 |
| Bleaching powder, f. o. b., wks., drums, cwt | 2.00 – 2.10 | 2.00 – 2.10 | 2.00 – 2.10 |
| Borax, gran., bags, ton | 48.00 –51.00 | 48.00 –51.00 | 48.00 –51.00 |
| Bromine, cs., lb | .30 – .32 | .30 – .32 | .30 – .32 |
| Calcium acetate, bags | 1.65 –...... | 1.65 –...... | 1.65 –...... |
| Arsenate, dr., lb | .06½– .07 | .06½– .07 | .06½– .07 |
| Carbide drums, lb | .05 – .06 | .05 – .06 | .05 – .06 |
| Chloride, fused, dr., del., ton | 21.50 –24.50 | 21.50 –24.50 | 21.50 –24.50 |
| flake, dr., del., ton | 23.00 –25.00 | 23.00 –25.00 | 23.00 –25.00 |
| Phosphate, bbl., lb | .07½– .08 | .07½– .08 | .07½– .08 |
| Carbon bisulphide, drums, lb | .05 – .06 | .05 – .06 | .05 – .06 |
| Tetrachloride drums, lb | .04¾– .05½ | .04¾– .05½ | .05½– .06 |
| Chlorine, liquid, tanks, wks., lb | 1.75 –...... | 1.75 –...... | 2.15 –...... |
| Cylinders | .05½– .06 | .05½– .06 | .05½– .06 |
| Cobalt oxide, cans, lb | 1.67 – 1.70 | 1.67 – 1.70 | 1.67 – 1.70 |
| Copperas, bgs., f. o. b., wks., ton | 15.00 –16.00 | 15.00 –16.00 | 15.00 –16.00 |
| Copper carbonate, bbl., lb | .10 – .16½ | .10 – .16½ | .09 – .16 |
| Sulphate, bbl., cwt | 4.25 – 4.50 | 4.25 – 4.50 | 4.25 – 4.50 |
| Cream of tartar, bbl., lb | .22½– .23 | .22½– .23 | .21½– .22 |
| Diethylene glycol, dr., lb | .22 – .23 | .22 – .23 | .22 – .23 |
| Epsom salt, dom., tech., bbl., cwt | 1.80 – 2.00 | 1.80 – 2.00 | 1.80 – 2.00 |
| Ethyl acetate, drums, lb | .061–...... | .061–...... | .06½–...... |
| Formaldehyde, 40%, bbl., lb | .05¾– .06½ | .05¾– .06½ | .05¾– .6½ |
| Furfural, tanks, lb | .09 –...... | .09 –...... | .09 –...... |
| Fusel oil, ref. drums, lb | .12½– .14 | .12½– .14 | .12½– .14 |
| Glaubers salt, bags, cwt | .95 – 1.00 | .95 – 1.00 | .95 – 1.00 |
| Glycerine, c.p., drums, extra, lb | .12½–...... | .12½–...... | .16½–...... |
| Lead: | | | |
| White, basic carbonate, dry casks, lb | .07 –...... | .07 –...... | .06½–...... |
| White, basic sulphate, sck., lb | .06½–...... | .06½–...... | .06½–...... |
| Red, dry, sck., lb | .076 –...... | .0735–...... | .074–...... |
| Lead acetate, white crys., bbl., lb | .10 – .11 | .10 – .11 | .10 – .11 |
| Lead arsenate, powd., bbl., lb | .10 – .10½ | .10 – .10½ | .12½– .13 |
| Lime, chem., bulk, ton | 8.50 –...... | 8.50 –...... | 8.50 –...... |
| Litharge, pwd., csk., lb | .0635...... | .06½–...... | .064–...... |
| Lithophone, bags, lb | .04 – .04½ | .04 – .04½ | .04½– .05 |
| Magnesium carb., tech., bags, lb | .06 – .06½ | .06 – .06½ | .06 – .06½ |

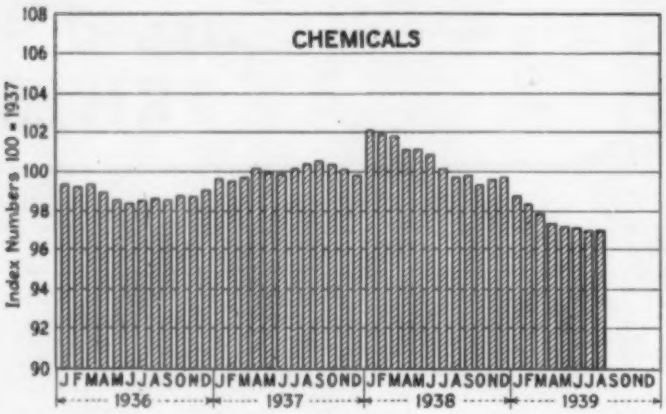
| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Methanol, 95%, tanks, gal | .31 –...... | .31 –...... | .31 –...... |
| 97%, tanks, gal | .32 –...... | .32 –...... | .32 –...... |
| Synthetic, tanks, gal | .33 –...... | .33 –...... | .33 –...... |
| Nickel salt, double, bbl., lb | .13 – .13½ | .13 – .13½ | .13 – .13½ |
| Orange mineral, csk., lb | .10½–...... | .10½–...... | .10½–...... |
| Phosphorus, red, cases, lb | .40 – .42 | .40 – .42 | .40 – .42 |
| Yellow, cases, lb | .18 – .25 | .18 – .25 | .24 – .30 |
| Potassium bichromate, casks, lb | .08½– .09 | .08½– .09 | .08½– .09 |
| Carbonate, 80–85%, calc. csk., lb | .06½– .07 | .06½– .07 | .06½– .07 |
| Chlorate, powd., lb | .09½–...... | .09½–...... | .09½–...... |
| Hydroxide (c'stic potash) dr., lb | .07 – .07½ | .07 – .07½ | .07 – .07½ |
| Muriate, 80% bgs., unit | .53½–...... | .53½–...... | .53½–...... |
| Nitrate, bbl., lb | .05½– .06 | .05½– .06 | .05½– .06 |
| Permanganate, drums, lb | .18½– .19 | .18½– .19 | .18½– .19 |
| Prussate, yellow, caks, lb | .14 – .15 | .14 – .15 | .15 – .16 |
| Sal ammoniac, white, casks, lb | .05 – .05½ | .05 – .05½ | .05 – .05½ |
| Salsoda, bbl., cwt | 1.00 – 1.05 | 1.00 – 1.05 | 1.00 – 1.05 |
| Salt cake, bulk, ton | 13.00 –15.00 | 13.00 –15.00 | 13.00 –15.00 |
| Soda ash, light, 58%, bags, contract, cwt | 1.05 –...... | 1.05 –...... | 1.05 –...... |
| Dense, bags, cwt | 1.10 –...... | 1.10 –...... | 1.10 –...... |
| Soda, caustic, 76%, solid, drums, cwt | 2.30 – 3.00 | 2.30 – 3.00 | 2.30 – 3.00 |
| Acetate, works, bbl., lb | .04 – .05 | .04 – .05 | .04½– .05 |
| Bicarbonate, bbl., cwt | 1.70 – 2.00 | 1.70 – 2.00 | 1.75 – 2.00 |
| Bichromate, casks, lb | .06¾– .07 | .06¾– .07 | .06¾– .07 |
| Bisulphate, bulk, ton | 15.00 –16.00 | 15.00 –16.00 | 15.00 –16.00 |
| Bisulphite, bbl., lb | .03½– .04 | .03½– .04 | .03½– .04 |
| Chlorate, kegs, lb | .06¼– .06½ | .06¼– .06½ | .06¼– .06½ |
| Cyanide, cases, dom., lb | .14 – .15 | .14 – .15 | .14 – .15 |
| Fluoride, bbl., lb | .07½– .08 | .07½– .08 | .07½– .08 |
| Hyposulphite, bbl., cwt | 2.40 – 2.50 | 2.40 – 2.50 | 2.40 – 2.50 |
| Metasilicate, bbl., cwt | 2.20 – 3.20 | 2.20 – 3.20 | 2.15 – 3.15 |
| Nitrate, bulk, cwt | 1.35 –...... | 1.35 –...... | 1.45 –...... |
| Nitrite, casks, lb | .06¾– .07 | .06¾– .07 | .07 – .08 |
| Phosphate, dibasic, bags, lb | 1.85 –...... | 1.85 –...... | 1.85 – .024 |
| Prussiate, yel. drums, lb | .09½– .10 | .09½– .10 | .09½– .10 |
| Silicate (40° dr.) wks., cwt | .80 – .85 | .80 – .85 | .80 – .85 |
| Sulphide, fused, 60–62%, dr., lb | .02¾– .03½ | .02¾– .03 | .02¾– .03 |
| Sulphite, crys., bbl., lb | .02¼– .02½ | .02¼– .02½ | .02¼– .02½ |
| Sulphur, crude at mine, bulk, ton | 16.00 –...... | 16.00 –...... | 18.00 –...... |
| Chloride, dr., lb | .03 – .04 | .03 – .04 | .03 – .04 |
| Dioxide, cyl., lb | .07 – .08 | .07 – .08 | .07 – .07½ |
| Flour, bag, cwt | 1.60 – 3.00 | 1.60 – 3.00 | 1.60 – 3.00 |
| Tin Oxide, bbl., lb | .52 –...... | .52 –...... | .48 –...... |
| Crystals, bbl., lb | .38 –...... | .38 –...... | .35 –...... |
| Zinc. chloride, gran., bbl., lb | .05 – .06 | .05 – .06 | .05 – .06 |
| Carbonate, bbl., lb | .14 – .15 | .14 – .15 | .14 – .15 |
| Cyanide, dr., lb | .33 – .35 | .33 – .35 | .33 – .35 |
| Dust, bbl., lb | .06½–...... | .06½–...... | .06½–...... |
| Zinc oxide, lead free, bag., lb | .06½–...... | .06½–...... | .06½–...... |
| 5% lead sulphate, bags, lb | .06½–...... | .06½–...... | .06½–...... |
| Sulphate, bbl., cwt | 2.75 – 3.00 | 2.75 – 3.00 | 3.15 – 3.60 |

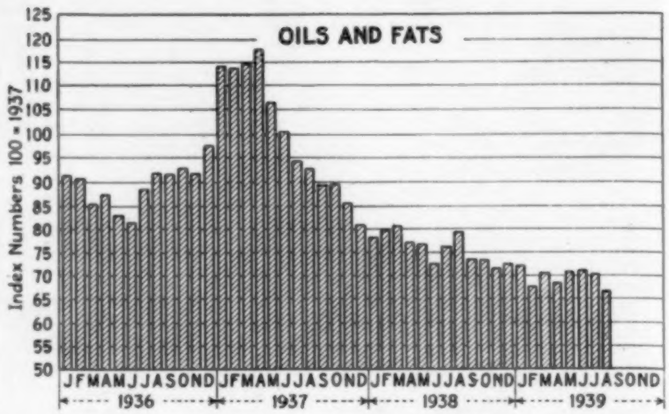
## OILS AND FATS

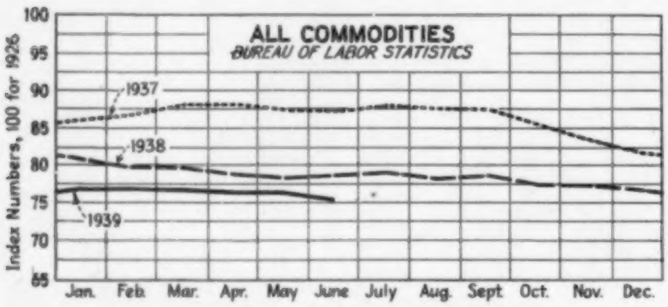
| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Castor oil, 3 bbl., lb | $0.08½–$0.10 | $0.08½–$0.10 | $0.09½–$0.10 |
| Chinawood oil, bbl., lb | .22 –...... | .22 –...... | .14½–...... |
| Coconut oil, Ceylon, tank, N. Y., lb | .02½–...... | .03 –...... | .03¾–...... |
| Corn oil crude, tanks (f. o. b. mill), lb | .05 –...... | .05½–...... | .08 –...... |
| Cottonseed oil, crude (f. o. b. mill), tanks, lb | .04½–...... | .05½–...... | .07¾–...... |
| Linseed oil, raw car lots, bbl., lb | .087–...... | .091–...... | .086–...... |
| Palm, casks, lb | .03½–...... | .03¾–...... | .04 –...... |
| Peanut oil, crude, tanks (mill), lb | .05½–...... | .05¾–...... | .08½–...... |
| Rapeseed oil, refined, bbl., gal | .81 –...... | .80 –...... | .75 –...... |
| Soya bean, tank, lb | .04½–...... | .04½–...... | .06¾–...... |
| Sulphur (olive foots), bbl., lb | .06½–...... | .06¾–...... | .07¾–...... |
| Cod, Newfoundland, bbl., gal | .32 –...... | .32 –...... | .38 –...... |
| Menhaden, light pressed, bbl., lb | .056–...... | .064–...... | .069–...... |
| Crude, tanks (f. o. b. factory), gal | .24 –...... | .26 –...... | .30 –...... |
| Grease, yellow, loose, lb | .04 –...... | .04½–...... | .05½–...... |
| Oleo stearine, lb | .05¾–...... | .06 –...... | .08½–...... |
| Oleo oil, No. 1 | .06¾–...... | .06¾–...... | .09¼–...... |
| Red oil, distilled, d.p. bbl., lb | .07¾–...... | .07¾–...... | .08¾–...... |
| Tallow extra, loose, lb | .04½–...... | .04½–...... | .05½–...... |

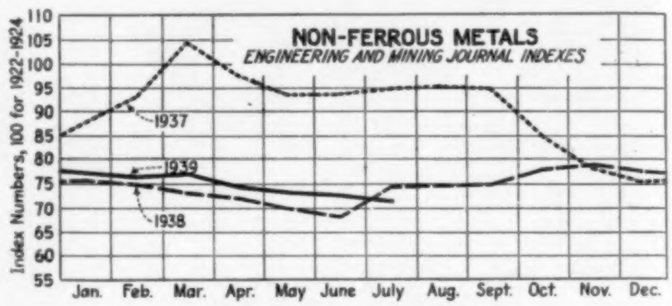
**The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Aug. 14**

# Chem. & Met.'s Weighted Price Indexes




## COAL-TAR PRODUCTS

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Alpha-napthol, crude bbl., lb | $0.52 -$0.55 | $0.52 -$0.55 | $0.52 -$0.55 |
| Alpha-naphthylamine, bbl., lb | .32 - .34 | .32 - .34 | .32 - .34 |
| Aniline oil, drums, extra, lb | .15 - .16 | .15 - .16 | .15 - .16 |
| Aniline, salts, bbl., lb | .22 - .24 | .22 - .24 | .22 - .24 |
| Benzaldehyde, U.S.P., dr., lb | .85 - .95 | .85 - .95 | .85 - .95 |
| Benzidine base, bbl., lb | .70 - .75 | .70 - .75 | .70 - .75 |
| Benzoic acid, U.S.P., kgs., lb | .54 - .56 | .54 - .56 | .54 - .56 |
| Benzyl cnloride, tech., dr., lb | .23 - .25 | .23 - .25 | .25 - .27 |
| Benzol, 90%, tanks, works, gal | .16 - .18 | .16 - .18 | .16 - .18 |
| Beta-napthol, tech., drums, lb | .23 - .24 | .23 - .24 | .23 - .24 |
| Cresol, U.S.P., dr., lb | .09½- .10 | .10 - .11 | .10½- .11 |
| Cresylic acid, dr., wks., gal | .55 - .57 | .69 - .71 | .78 - .80 |
| Diethylaniline, dr., lb | .40 - .45 | .40 - .45 | .40 - .45 |
| Dinitrophenol, bbl., lb | .23 - .25 | .23 - .25 | .23 - .25 |
| Dinitrotoluen, bbl., lb | .15 - .16 | .15 - .16 | .15 - .16 |
| Dip oil, 15%, dr., gal | .23 - .25 | .23 - .25 | .23 - .25 |
| Diphenylamine, bbl., lb | .32 - .36 | .32 - .36 | .32 - .36 |
| H-acid, bbl., lb | .50 - .55 | .50 - .55 | .50 - .55 |
| Naphthalene, flake, bbl., lb | .05½- .06 | .05½- .06 | .06½- .07 |
| Nitrobenzene, dr., lb | .08 - .09 | .08 - .09 | .08 - .09 |
| Para-nitraniline, bbl., lb | .47 - .49 | .47 - .49 | .50 - .52 |
| Phenol, U.S.P., drums, lb | .13 -...... | .13 -...... | .14½-...... |
| Picric acid, bbl., lb | .35 - .40 | .35 - .40 | .35 - .40 |
| Pyridine, dr., gal | 1.55 - 1.60 | 1.55 - 1.60 | 1.55 - 1.60 |
| Resorcinal, tech., kegs, lb | .75 - .80 | .75 - .80 | .75 - .80 |
| Salicylic acid, tech., bbl., lb | .33 - .40 | .33 - .40 | .33 - .40 |
| Solvent naptha, w.w., tanks, gal | .26 -...... | .26 -...... | .26 -...... |
| Tolidine, bbl., lb | .86 - .88 | .86 - .88 | .88 - .90 |
| Toluene, tanks, works, gal | .27 -...... | .27 -...... | .26 -...... |
| Xylene, com, tanks, gal | .26 -...... | .26 -...... | .26 -...... |

## MISCELLANEOUS

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Barytes, grd., white, bbl., ton | $22.00-$25.00 | $22.00-$25.00 | $22.00-$25.00 |
| Casein, tech., bbl., lb | .11½- .12 | .09 - .11 | .09 - .11 |
| China clay, dom., f.o.b. mine, ton | 8.00 -20.00 | 8.00 -20.00 | 8.00 -20.00 |
| Dry colors | | | |
| Carbon gas, black (wks.), lb | .02½- .30 | .02½- .30 | .02½- .30 |
| Prussian blue, bbl., lb | .36 - .37 | .36 - .37 | .36 - .37 |
| Ultramarine blue, bbl., lb | .10 - .26 | .10 - .26 | .10 - .26 |
| Chrome green, bbl., lb | .21 - .30 | .21 - .30 | .21 - .27 |
| Carmine red, tins, lb | 4.35 - 4.40 | 4.35 - 4.40 | 4.00 - 4.40 |
| Para toner, lb | .75 - .80 | .75 - .80 | .75 - .80 |
| Vermilion, English, bbl., lb | 1.57 - 1.58 | 1.57 - 1.58 | 1.45 - 1.50 |
| Chrome yellow, C.P., bbl., lb | .14½- .15½ | .14½- .15½ | .14½- .15½ |
| Feldspar, No. 1 (f.o.b. N.C.), ton | 6.50 - 7.50 | 6.50 - 7.50 | 6.50 - 7.50 |
| Graphite, Ceylon, lump, bbl., lb | .06 - .06½ | .06 - .06½ | .06 - .06½ |
| Gum copal Congo, bags, lb | .06 - .30 | .06 - .30 | .06 - .30 |
| Manila, bags, lb | .07 - .14 | .07 - .14 | .09 - .14 |
| Damar, Batavia, cases, lb | .07½- .20 | .07½- .20 | .08 - .24 |
| Kauri cases, lb | .17½- .60 | .17½- .60 | .18½- .60 |
| Kieselguhr (f.o.b. N. Y.), ton | 50.00 -55.00 | 50.00 -55.00 | 50.00 -55.00 |
| Magnesite, calc, ton | 50.00 -...... | 50.00 -...... | 50.00 -...... |
| Pumice stone, lump, bbl., lb | .05 - .07 | .05 - .06 | .05 - .07 |
| Imported, casks, lb | .03 - .04 | .03 - .04 | .03 - .04 |
| Rosin, H., bbl | 6.45 -...... | 6.40 -...... | 5.95 -...... |
| Turpentine, gal | .29½-...... | .30 -...... | .28½-...... |
| Shellac, orange, fine, bags, lb | .19 -...... | .19 -...... | .20 -...... |
| Bleached, bonedry, bags, lb | .18 -...... | .18 -...... | .18 -...... |
| T. N. Bags, lb | .09½-...... | .10 -...... | .11 -...... |
| Soapstone (f.o.b. Vt.), bags, ton | 10.00 -12.00 | 10.00 -12.00 | 10.00 -12.00 |
| Talc, 200 mesh (f.o.b. Vt.), ton | 8.00 - 8.50 | 8.00 - 8.50 | 8.00 - 8.50 |
| 300 mesh (f.o.b. Ga.), ton | 7.50 -10.00 | 7.50 -10.00 | 7.50 -11.00 |
| 225 mesh (f.o.b. N. Y.), ton | 13.75 -...... | 13.75 -...... | 13.75 -...... |

## INDUSTRIAL NOTES

SPANG, CHALFANT, INC., Pittsburgh, has elected George E. Clifford as vice-president in charge of sales. Mr. Clifford will be located in the main offices of the company.

WESTVACO CHLORINE PRODUCTS CORP., New York, has acquired control of the Magnesol Co. Officers of the new company are Maurice E. Gilbert, president, Louis Neuberg, Albert M. Pitcher, and Max V. Seaton, vice-presidents, and William N. Williams, secretary-treasurer.

LAMOTTE CHEMICAL PRODUCTS Co., Baltimore, has moved its offices and laboratories into its own new building in Towson, Md.

AJAX FLEXIBLE COUPLING Co., Westfield, N. Y., has appointed the Urquhart Co., Denver, Colo., as representatives in the Intermountain territory.

AMERICAN MACHINE AND METALS, INC., Tolhurst Centrifugal Division, East Moline, Ill., has appointed Wayne Mendell to supervise sales activities in the Chicago area with headquarters at 35 East Wacker Drive.

FREEPORT SULPHUR Co., New York, has appointed T. J. Knapp as assistant sales manager. Since 1930, Mr Knapp had been traffic manager at the company's New York office.

HERCULES POWDER Co., Wilmington, has added N. Judson Miller to the sales staff of its Providence Drysalters Division to serve the textile industry in the Carolinas. His headquarters will be at Charlotte, N. C.

ATLAS MINERAL PRODUCTS Co., Mertztown, Penna., has appointed A. M. Younger to its technical sales staff and he will have charge of sales in the Chicago territory.

SINGER MFG. Co., Elizabethport, N. J., has announced that its Electrical Division, the Diehl Mfg Co., has opened an office in Charlotte, N. C., in charge of James H. Lewis.

RAYBESTOS-MANHATTAN, INC., New York, has elected W. H. Dunn as secretary to succeed the late Morton F. Judd. Mr. Dunn is connected with the Manhattan Rubber Mfg. Division in Passic, N. J.

# *New* CONSTRUCTION

| | Current Project | | Cumulative 1939 | |
|---|---|---|---|---|
| | Proposed Work | Contracts | Proposed Work | Contracts |
| New England | $250,000 | .......... | $1,335,000 | $1,400,000 |
| Middle Atlantic | 50,000 | $1,950,000 | 4,850,000 | 12,447,000 |
| South | .......... | 1,000,000 | 8,733,000 | 10,115,000 |
| Middle West | 440,000 | 340,000 | 13,525,000 | 2,575,000 |
| West of Mississippi | 40,000 | 3,757,000 | 5,465,000 | 5,134,000 |
| Far West | .......... | .......... | 2,270,000 | 1,601,000 |
| Canada | 3,250,000 | .......... | 8,860,000 | 5,055,000 |
| Total | $4,030,000 | $7,047,000 | $45,038,000 | $38,327,000 |

## PROPOSED WORK

**Brass Factory**—Keeler Brass Co., 947 Godfrey St., S. W., Grand Rapids, Mich., is having plans prepared by Robinson, Campan & Crowe, Archts., 760 Michigan Trust Bldg., Grand Rapids, for the construction of a 1 story brass factory. Estimated cost $50,000.

**Chemical Plant**—Cartier Chemical Co., Ltd., S. Hayes, 132 St. James St., W., Montreal, Que., Can., contemplates the construction of a chemical plant. Estimated cost $50,000.

**Chemical Plant**—R. & C. Windecker, Painesville, O., have acquired a 65 acre site west of Painesville and plan to construct a 1 story chemical products plant. Estimated cost will exceed $40,000.

**Chemistry Building** — University of Maine, Orono, Me., is having plans prepared for the construction of a chemistry building. Estimated cost $250,000.

**Factory**—Insulation Products, Ltd., Bon Valley Rd., Toronto, Ont., Can., plans to construct a factory on Beechwood Dr., East York, Ont. A. H. Vanderburgh, Gen. Mgr. Estimated cost $40,000.

**Factory**—Masonite Co. of Canada, Ltd., S. L. DeCartered, Pres., Gatineau, Que., Can., plans to construct a factory near Hull, Que. Estimated cost $150,000.

**Fertilizer Plant**—Ohio Farm Bureau, Farm Bureau Bldg., Columbus, O., plans to construct a dry mixing fertilizer plant at Cincinnati, O. Estimated cost $200,000.

**Gas Plant**—Community Gas Ltd., R. R. McMurthy, 350 Bay St., Toronto, Ont., Can., plans to construct a gas plant. Estimated cost $50,000.

**Laboratory**—Corning Glass Co., Corning, N. Y., plans to construct a 5 story, 80x125 ft. laboratory. Estimated cost will exceed $50,000.

**Gasoline Refinery**—Shell Oil Co., Inc., Atlantic Refining Co. and Petroleum Finance Corp., c/o Shell Petroleum Corp., Shell Bldg., St. Louis, Mo., plan to construct a natural gasoline extraction plant in the Magnolia Oil field of Columbia Co., Ark., to have an intake capacity of 15,000,000 cu. ft. gas daily.

**Oil Refinery**—Direct Oil Refinery, Ltd., Edmonton, Alta., Can., is negotiating for a site for the construction of an oil refinery. Estimated cost $100,000.

**Oil Refinery**—Imperial Oil, Ltd., 56 Church St., Toronto, Ont., Can., plans to construct a refinery at Fort Norman, N. W. T., Can. Bids are now being received by owners for tanks, etc. Estimated cost $150,000.

**Oil Refinery**—Pacific Petroleum, Ltd., W. N. Graburn, Mgr., Vancouver, B. C., Can., plans to construct a refinery at Calgary, Alta. Estimated cost $100,000.

**Paint Factory**—Sherwin-Williams Co. of Canada, Ltd., 2875 Centre St., Montreal, Que., Can., is having plans prepared by Ross & MacDonald, Archts., Belmont St., Montreal, for an addition to its paint and varnish factory. Estimated cost $70,000.

**Paper Mill**—Interlake Tissue Co., Ltd., 388 University Ave., Toronto, Ont., Can., plans to construct an addition to its mill. N. Wagner, 378 Queen St., S., Hamilton, Ont., Archt. Estimated cost $40,000.

**Rayon Mill**—Vancouver Rayon Silks, Ltd., Paul Zuest, Mgr., Victoria, B. C., Can., has purchased a 32 acre site on the water front at North Vancouver, B. C., and plans to construct a rayon mill. Estimated cost $2,500,000.

**Shoe Polish Factory**—Hecker Products Corp., 1437 West Morris St., Indianapolis, Ind., manufacturer of shoe polishes, will soon award the contract for a 3 story, 100x128 ft. addition to its factory. Lockwood, Green, Inc., Rockefeller Plaza, New York, N. Y., Engr. Estimated cost $100,000.

**Warehouse**—Michigan Carton Co., Battle Creek, Mich, is having plans prepared by Shreve, Anderson & Walker, Archts., 914 Marquette Bldg., Detroit, for the construction of a 2 story warehouse. Estimated cost $50,000.

## CONTRACTS AWARDED

**Box Factory**—Erie Corrugated Box Co., 922 Bacon St., Erie, Pa., has awarded the contract for a factory to E. E. Austin & Sons, 20th and Read Sts., Erie, Pa. Estimated cost will exceed $40,000.

**Fertilizer Factory**—Farm Bureau Cooperative Assn., 248 North High St., Columbus, O., will construct 1 story, 130x320 ft. factory at Indianapolis, Ind., and 1 story, 125x210 ft. factory at Maumee, O. Work will be done by separate contracts which are being awarded by owner and Carlton, Frankenberger & Batson, Archts., 1816 Central Pkwy., Cincinnati.

**China Factory** — French-Saxon China Co., Sebring, O., has awarded the contract for a circular bisque kiln to Allied Engineering Co., 4150 East 56th St., Cleveland. Estimated cost $45,000.

**Factory**—E. I. du Pont de Nemours & Co., Tonawanda, N. Y., will construct an addition to its factory. Work will be done with owner's forces. Estimated cost will exceed $40,000.

**Factory**—National Chemical & Manufacturing Co., 3617 South May St., Chicago, Ill., manufacturer of Luminal and "outside" Luminal paints, has awarded the contract for alterations and addition to its factory to Poirot Construction Co., 2001 West Pershing Rd., Chicago. Estimated cost $35,000.

**Factory**—Vanadium Corp. of America, Saunders Settlement Rd., Niagara Falls, N. Y., has awarded the contract for an addition to its factory to Walter S. Johnson Bldg. Corp., Hyde Park Blvd., Niagara Falls. Estimated cost will exceed $40,000.

**Glass Factory**—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., plans to modernize its plant at Ford City, Pa. Plans include modernization of plate glass tank, furnace and portion of pot furnaces will be replaced with continuous tank and lehr. No new buildings will be constructed but bids will be taken soon for equipment. Contract for foundations has been let to Foundation Co., 120 Liberty St., New York, N. Y. Ralph D. Bole, Ch. Engr. Estimated cost $1,700,000.

**Match Factory**—Diamond Match Co., Monticello St., Oswego, N. Y., has awarded the contract for an addition to its factory to James Leck Co., 211 South 11th St., Minneapolis, Minn. Estimated cost will exceed $50,000.

**Paper Mill**—Champion Paper & Fiber Co., Enquirer Bldg., Cincinnati, O., has awarded the contract for a finishing mill at Pasadena, near Houston, Tex., to Merritt, Chapman & Scott Corp., 17 Battery Pl., New York, N. Y. Estimated cost $3,000,000.

**Paper Mill**—Imperial Paper & Color Corp., Plattsburgh, N. Y., has awarded the contract for an addition to its plant to Wright & Morrissey Co., Burlington, Vt. Estimated cost $40,000.

**Paper Mill**—Rhinelander Paper Co., Rhinelander, Wis., has awarded the contract for a 2 story, 94x48 ft. factory to C. R. Meyers & Sons Co., 50 State St., Oshkosh, Wis.

**Pyroxylin Factory**—Pyroxylin Products, Inc., 4851 South St. Louis St., Chicago, Ill., has awarded the contract for an addition to its factory to Welso Construction Co., 2233 West Grand Ave., Chicago.

**Condensate Plant**—Clyde H. Alexander and Robert T. Wilson, 222 Roseborough St., San Antonio, Tex., and associates, have awarded the contract for a 150,000,000 cu. ft. condensate plant and recycling unit in the Agua Dulce field, Neuces Co., about 40 mi. northwest of Corpus Christi, to Stearns-Roger Manufacturing Co., c/o E. E. DeBeck, Corpus Christi, Tex. Estimated cost $250,000.

**Refinery**—Standard Oil Co., Midland Bldg., Cleveland, O., has awarded the contract for catalytic pulverization plant addition on Cedar Rd., Toledo, O., to M. W. Kellogg Construction Co., 225 Bway., New York, N. Y. Estimated cost $100,000.

**Research Laboratory**—Ethyl Gasoline Corp., 320 Yonkers Ave., Yonkers, N. Y., will construct a 1 story, 114x120 ft. research laboratory at 1050 Nepperham Ave., Yonkers. Work will be done by owners.

**Rubber Factory**—B. F. Goodrich Co., H. E. Cook, Gen. Supt., Eng. Div., 500 South Main St., Akron, O., has awarded the contract for a 1 story, 200x800 ft. plant at Clarksville, Tenn., to Batson-Cook Co., West Point, Ga. Estimated cost $1,000,000.

**Soy Bean Processing Plant**—Soy Bean Processing Co., C. E. Buller, Pres., 1600 Westfield Ave., Waterloo, Ia., has awarded the contract for a plant to Chalmers & Borton, Hutchinson, Kan. Estimated cost $43,000.

**Warehouse**—Hicks Rubber Co., c/o E. A. Hicks, Waco, Tex., has awarded the contract for a 1 and 2 story warehouse to Smith Building Co., 2501 Colcord St., Waco, at $29,952. Total estimated cost $424,000.

**Warehouse**—Reineke Wall Paper & Paint Co., 2137 Gravois Ave., St. Louis, Mo., has awarded the contract for a 1 story, 58x118 ft. 8 in. warehouse to William Reiter, 523A Eiler Ave., St. Louis.

## PRODUCTION OF VEGETABLE OILS FALLS BELOW CORRESPONDING TOTAL FOR LAST YEAR

PRODUCTION of crude vegetable oils in the first half of this year amounted to 1,423,243 thousand pounds compared with 1,492,483 thousand pounds in the like period of last year. The smaller total for this year may be attributed entirely to the smaller crush of cottonseed as crude cottonseed oil production this year was 250,068 thousand pounds below the 1938 figure. With the exception of coconut, other vegetable oils were turned out in larger volume this year.

Comparative figures again point to the growing importance of soybean oil as a domestic product. In the first six months of 1938, production gained nearly 47 per cent over the output for the comparable period of 1937 and this year the gain was almost 55 per cent over the 1938 figure. The trend toward enlarged outputs from domestic oil-bearing materials was also exemplified in the case of peanut and corn oils, each of which was in larger supply than had been the case in the first half of 1938. Babassu oil became more of a market factor in recent months with importations of 32,456 tons of nuts and kernels in the Jan.–June period this year and an output of 36,834 thousand pounds of oil. The high prices which have prevailed for tung oil have turned attention to other drying oils and imports of such oils as perilla and oiticica have increased.

A material drop in the volume of cottonseed oil refined resulted in a smaller total for all refined oil production for this year, the totals for the six-month periods being, 1,173,403 thousand pounds for 1939 and 1,324,046 thousand pounds for 1938. Keener competition from animal fats served to cut down buying of refined oils on the part of the edible trades. Here again soybean oil stands out because of its percentage rise, its course being described by 82,503 thousand pounds in 1937, 100,718 thousand pounds in 1938, and 177,887 thousand pounds in 1939.

For the calendar year 1938, the Bureau of the Census reported that factory consumption of soybean oil reached a total of 243,613 thousand pounds for that year. Of this amount 194,483 thousand pounds went to the edible trades with crude oil consumption given as: 10,897 thousand pounds for soap; 15,183 thousand pounds for paint and varnish; 3,605 thousand pounds for linoleum and oilcloth; 59 thousand pounds for printing ink; and 5,340 thousand pounds for miscellaneous uses, although the latter figure may not refer entirely to crude oil.

Although there is a relatively small domestic production of tung oil, the Census reports have not yet deemed this important enough to give details but have included it in the "all other" classification. Imports of tung oil—or China wood oil—for consumption for the first six months of the current year amounted to 39,469 thousand pounds. From Jan. 1 to June 30, there was a reduction of 20,178 thousand pounds in stocks held in factories and warehouses so the apparent consumption for the first half of the year works out at 59,646 thousand pounds.

As an indication of the extent to which vegetable oils so far this year have been replaced by animal fats, it may be pointed out that factory consumption of lard this year was 7,824 thousand pounds against 1,255 thousand pounds in 1938. Factory consumption of inedible tallow offers the comparison of 409,198 thousand pounds for this year and 348,874 thousand pounds for last year, the figures in each case referring to the first half of the year.

Stocks of vegetable oils were lower at the close of June than they were at the beginning of the year, the totals being 1,570 million pounds and 1,490 million pounds respectively. Drying oils aided in the drop in the surplus with a loss of more than 11 million pounds in linseed and 20 million pounds in tung. With the possible exception of linseed oil this is a condition which may become more acute over the remainder of the year. While the carryover of refined cottonseed oil gained in the six-month period the total for crude and refined cottonseed was lower than on Jan. 1. The larger supply of soybean oil resulted in only a moderate increase in unsold stocks.

Palm oil made a creditable showing from all angles, larger amounts were refined and consumption increased accordingly so that stocks were drawn upon to fill consuming needs and the visible on June 30 was almost 50 million pounds under the carryover at the beginning of the year.

The price trend for oils and fats has been downward for the year to date. The weighted index number of *Chem. & Met.* stood at 72.02 in January and had dropped to 70.33 in July. In the current market such oils as tung, perilla, and oiticica are running counter to the general price trend with difficulty in obtaining supplies from primary points as the dominating price factor.

**Factory Production, Consumption, and Stocks of Vegetable Oils First Half of Year**

| | Production, 1,000 lb. | | | Consumption, 1,000 lb. | | | Stocks, 1,000 lb. | |
|---|---|---|---|---|---|---|---|---|
| | 1939 | 1938 | 1937 | 1939 | 1938 | 1937 | Dec. 31, 1938 | June 30, 1939 |
| Cottonseed, crude | 576,672 | 826,740 | 519,923 | 679,399 | 990,589 | 665,049 | 175,464 | 88,828 |
| Cottonseed, refined | 639,965 | 892,951 | 622,828 | 558,200 | 737,126 | 665,049 | 565,309 | 614,470 |
| Peanut, virgin and crude | 60,248 | 54,402 | 40,593 | 53,758 | 43,057 | 40,765 | 7,564 | 13,939 |
| Peanut, refined | 51,659 | 40,760 | 38,042 | 30,108 | 29,653 | 34,790 | 18,794 | 33,893 |
| Coconut, crude | 141,845 | 145,133 | 118,298 | 292,299 | 272,925 | 242,200 | 202,384 | 226,894 |
| Coconut, refined | 143,277 | 150,078 | 135,676 | 118,031 | 136,343 | 111,817 | 13,335 | 12,314 |
| Corn, crude | 68,812 | 63,626 | 69,781 | 73,402 | 71,579 | 82,245 | 14,725 | 15,674 |
| Corn, refined | 65,152 | 65,272 | 73,714 | 36,866 | 32,851 | 35,852 | 12,325 | 10,262 |
| Soybean, crude | 225,858 | 145,783 | 99,332 | 200,200 | 115,807 | 94,162 | 49,577 | 47,793 |
| Soybean, refined | 177,887 | 100,718 | 82,503 | 144,594 | 83,902 | 82,564 | 25,505 | 42,421 |
| Olive, edible | .......... | 3,388 | 1,829 | 1,606 | 1,431 | 1,998 | 4,950 | 7,637 |
| Olive, inedible | .......... | 2 | .......... | 2,361 | 1,820 | 3,716 | 862 | 1,115 |
| Sulphur oil or olive foots | .......... | .......... | .......... | 8,999 | 6,979 | 10,763 | 12,420 | 14,190 |
| Palm-kernel, crude | .......... | .......... | .......... | 7,744 | 34,911 | 64,282 | 4,050 | 611 |
| Palm-kernel, refined | 4,222 | 8,880 | 16,302 | 5,175 | 10,081 | 19,387 | 2,263 | 2,028 |
| Palm, crude | .......... | .......... | .......... | 150,943 | 124,548 | 141,061 | 143,679 | 99,132 |
| Palm, refined | 76,807 | 53,360 | 67,218 | 70,532 | 50,773 | 67,215 | 18,759 | 27,661 |
| Babassu, crude | 36,834 | 20,264 | 21,185 | 29,660 | 18,063 | 21,303 | 1,463 | 9,723 |
| Babassu, refined | 14,434 | 12,027 | 12,131 | 12,551 | 13,484 | 18,556 | 278 | 608 |
| Rapeseed | .......... | .......... | .......... | 2,922 | 2,358 | 9,282 | 2,959 | 3,148 |
| Linseed | 264,032 | 203,100 | 363,389 | 168,034 | 145,447 | 214,182 | 141,803 | 130,310 |
| Tung | .......... | .......... | .......... | 51,856 | 42,748 | 68,266 | 61,189 | 41,011 |
| Perilla | .......... | .......... | .......... | 19,814 | 16,467 | 24,399 | 13,622 | 13,439 |
| Castor | 34,981 | 24,018 | 36,858 | 17,505 | 12,800 | 19,352 | 17,187 | 18,576 |
| Sesame | .......... | .......... | .......... | 1,085 | 4,177 | 17,981 | 205 | 563 |
| All other | 7,457 | 6,027 | 14,594 | 17,821 | 13,601 | 12,240 | 16,341 | 14,570 |